Regulatory Requirements for Transportation, Storage, Aging, and Disposal

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United States Nuclear Regulatory Commission

NRC/DOE Technical Exchange and Management Meeting
August 29, 2006

Outline

- Purpose
- Proposed DOE Approach
- Regulatory Framework
- Part 71 and 72 Requirements
- Part 63 Requirements
- Summary

Purpose

- To provide NRC perspective on the DOE proposal of a standardized canister for transport, aging and disposal (TAD)
- NRC communicated this information to DOE in a letter dated August 10, 2006
  - regulatory framework
  - cross-cutting issues between regulations
  - technical aspects relevant to Part 63
  - quality assurance

Proposed DOE Approach

- TAD canister loaded with spent nuclear fuel in pool and welded shut at a nuclear power plant (NPP) (10 CFR 50)
- TAD could be placed in an Independent Spent Fuel Storage Installation (10 CFR 72) for interim storage
- TAD placed in an NRC-certified cask and transported (10 CFR 71)
- TAD potentially placed in a cask for aging incidental to operation of the repository at YM site (10 CFR 63)
- TAD placed in a disposal waste package for emplacement in the proposed YM repository (10 CFR 63)

TAD Implementation

- DOE to issue a performance specification for TAD to meet Parts 63/71 and possibly Part 72 requirements
- Cask vendors apply for a certificate of compliance for TAD in a cask from NRC under Part 71, and/or Part 72
- Utility could store the TAD in a storage cask at an NPP site under Part 72 specific license or Part 50/72 general license
- DOE to submit a license application under Part 63 using TADs described in the application

Regulatory Framework

- Part 71 Packaging and Transportation of Radioactive Materials
- Part 72 Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste
- Part 63 Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada

Parts 71 and 72 Requirements

Robert Lewis

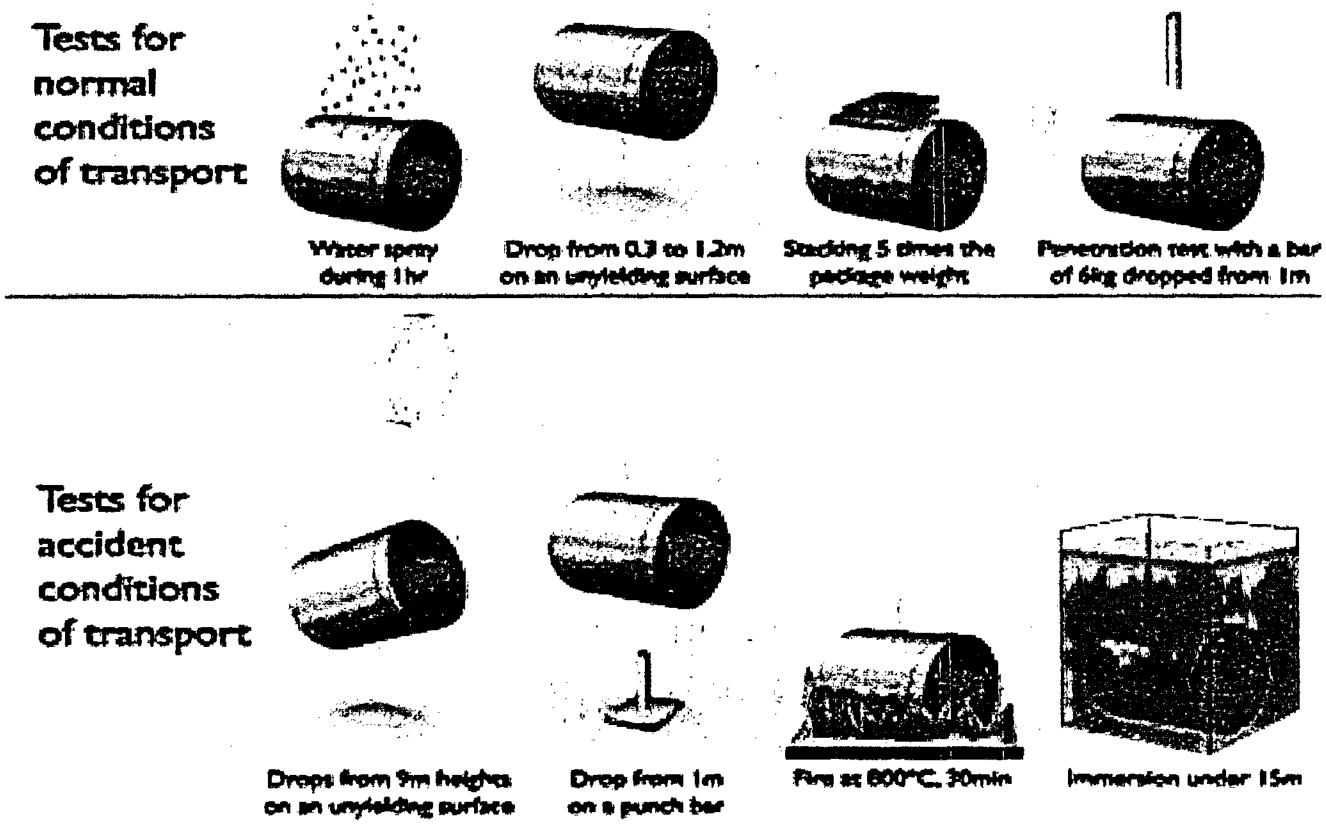
Part 71 Certificate of Compliance

- Explicit Acceptance Criteria (71.51 & 71.55) – provide containment, shielding, prevent criticality under:
  - Normal Conditions of Transport (71.71); and
  - Hypothetical Accident Conditions (71.73)

- Prescriptive guidance on format and content, and sub-tier acceptance criteria/approaches found acceptable
  - Regulatory Guide 7.9
  - Standard Review Plan (NUREG-1617)
  - Interim Staff Guidance

- If the staff safety review concludes that the regulations are satisfied, NRC issues a Certificate of Compliance (CoC) with conditions that must be met by vendors and users

Part 71 Tests



Part 72 Certificate of Compliance

- Combination of explicit and derived acceptance criteria
  - Explicit criteria
    - Subcriticality, Shielding, Confinement, Heat Removal (72.236)
  - Derived criteria
    - Design Basis Accidents and Natural Phenomena (72.92) (e.g., tornados, earthquakes, floods, lightning, tsunami, hurricanes)
    - Utilities using a Certificate of Compliance must ensure retrievability (72.122) and limit accident dose at site boundary (72.106)

Part 72 Certificate of Compliance (contd.)

- SRP (NUREG-1536) and ISGs
- After safety review, rulemaking (72.214)
- If the staff safety review concludes that the regulations are satisfied, NRC issues a Certificate of Compliance and Technical Specifications, binding on vendors and users
- 72.48 change process applies

Part 72 Areas of Review

- Principal Design Criteria
- Structural
- Thermal
- Shielding
- Criticality
- Confinement
- Operating Procedures
- Acceptance Tests and Maintenance Program
- Radiation Protection
- Accident Analyses
- Conditions for Use
- Quality Assurance
- Decommissioning

Part 63 Requirements

Timothy McCartin

Regulatory Framework

Part 63

- Risk-informed, performance-based regulation
  - provides DOE flexibility to decide how to design the disposal facility
  - requires DOE to demonstrate that its design meets safety limits (dose limits)
  - requires DOE to develop and implement QA Program to assure design and safety of facility

Design Constraints (10 CFR 63)

- Pre-Closure Safety Assessment
  - is TAD canister important to safety?
- Post-Closure Safety Assessment
  - is TAD canister a barrier important to waste isolation?
  - can TAD canister affect performance?

Quality Assurance (Part 63)

- Quality Assurance (QA) program applies to structures, systems, and components important to safety; and barriers important to waste isolation

- QA Program may include:
  - physical characteristics
  - means to control quality to predetermined requirements
  - procurement
  - oversight
  - special processes
  - verification of work of entities that provide and load TAD canisters for DOE

Technical Aspects of TAD Canister
[preclosure operations]

- TAD canister approach may significantly impact preclosure operations and facility layout
- Demonstration of safety during event sequences at the proposed YM repository may be important to the design of the TAD canister
    - examination of potential hazards, initiating events and their resulting event sequences (e.g., canister drop)

Technical Aspects of TAD Canister
[post-closure considerations]

- TAD canister materials may affect in-package chemistry (e.g., pH, ionic strength)
- Integrity of the fuel cladding prior to emplacement
- Probability of criticality
  - verification of fuel burn-up
  - choice of neutron absorber materials

Summary

- Cross-cutting issues in the application of Parts 63, 71, and 72 should be identified and resolved during the development of the TAD canister technical specifications

- DOE has the responsibility for understanding the relationship between the technical specifications of the TAD canister and its performance in demonstrating compliance with the Part 63 safety requirements

U.S. Department of Energy

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

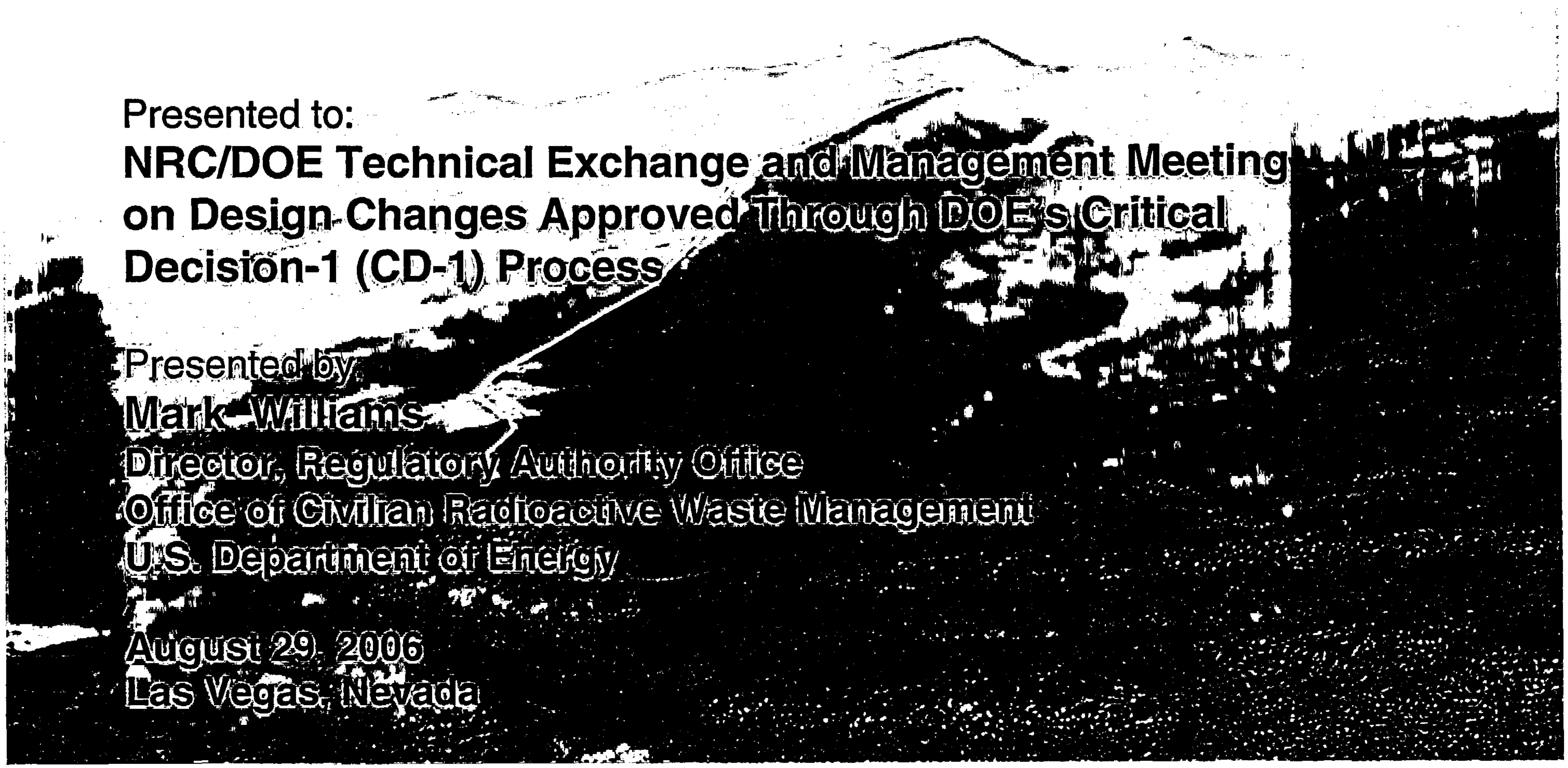
DOE/NRC Technical Exchange and Management Meeting on Design Changes Approved Through DOE's Critical Decision-1 (CD-1) Process

August 29, 2006
Las Vegas, NV

U.S. Department of Energy

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

Opening Remarks



Presented to:
NRC/DOE Technical Exchange and Management Meeting on Design Changes Approved Through DOE's Critical Decision-1 (CD-1) Process

Presented by:

Mark Williams
Director, Regulatory Authority Office
Office of Civilian Radioactive Waste Management
U.S. Department of Energy

August 29, 2006
Las Vegas, Nevada

Opening Remarks

- Welcome
- DOE's Critical Decision-1 (CD-1) Process
- Purpose is to summarize the recent changes approved on July 6, 2006, through DOE's CD-1 Process
- Goal is to describe the waste handling process
- Approved changes:
  - Reduce potential for contamination
  - Reduce risks at repository
  - Simplify waste handling process

Opening Remarks

- Design Control implemented per July 7, 2006, DOE letter to the NRC
- Submittal of License Application (LA) by June 30, 2008
- Sufficient design development to support detailed Preclosure Safety Analysis (PCSA)
- Sufficient design and safety analysis information presented in the LA for NRC safety determination that Performance Objectives are met

Additional NRC / DOE Interactions Planned For Remainder Of 2006

- Quarterly Management Meetings
- Preclosure topics including design and PCSA
- Transport, Aging, and Disposal (TAD) Canister
- Postclosure topics including criticality and igneous activity
- Total System Performance Assessment model
- Science and Technology

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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

Design Changes Approved Through DOE's CD-1 Process

Presented to:

NRC/DOE Technical Exchange and Management Meeting on Design Changes Approved Through DOE's Critical Decision-1 (CD-1) Process

Presented by:

Paul Harrington

Acting Chief Engineer

Office of Civilian Radioactive Waste Management

U.S. Department of Energy

August 29, 2006

Las Vegas, Nevada

Acronyms

CD-1	Critical Decision - 1
CRCF	Canister Receipt and Closure Facility
CSNF	Commercial Spent Nuclear Fuel
DHLW	Defense High Level Waste
GROA	Geologic Repository Operations Area
HEPA	High Efficiency Particulate Air (filter)
IHF	Initial Handling Facility
ITS	Important to Safety
MCO	Multi-Canister Overpack
QARD	Quality Assurance Requirements and Description
RF	Receipt Facility
TAD	Transport, Aging, and Disposal Canister
WHF	Wet Handling Facility

Summary of Design Changes Approved Through DOE's CD-1 Process

Discussion Outline:

- CD-1 Process and Design Control
- Site Layout
- Waste Handling Process
- Waste Package and TAD canister
- Subsurface
- Phased Construction and Operation

CD-1 Process and Design Control

- **CD-1 Process**
  - DOE internal approval of design concept and range cost estimate
  - Supporting documentation includes Conceptual Design Report (CDR) and Preliminary Hazard Analysis (PHA)
- **Design Control**
  - CD-1 alternatives development and evaluation captured in CDR, but are not licensing basis so were not performed under QARD
  - Development of design to support LA is to be done under QARD with full design control
  - Processes and procedures recently modified to improve design control

Summary of Design Changes Approved Through DOE's CD-1 Process

- TAD canister utilized
- TADs reduce handling of individual CSNF assemblies at repository
- Operational goal is 90% of individual CSNF assemblies loaded in TADs by utilities
- Limited quantity of uncanistered individual CSNF assemblies to be handled wet
- Reconfigured waste handling process and facilities
- Waste Package configuration suite revised for TADs
- IHF added

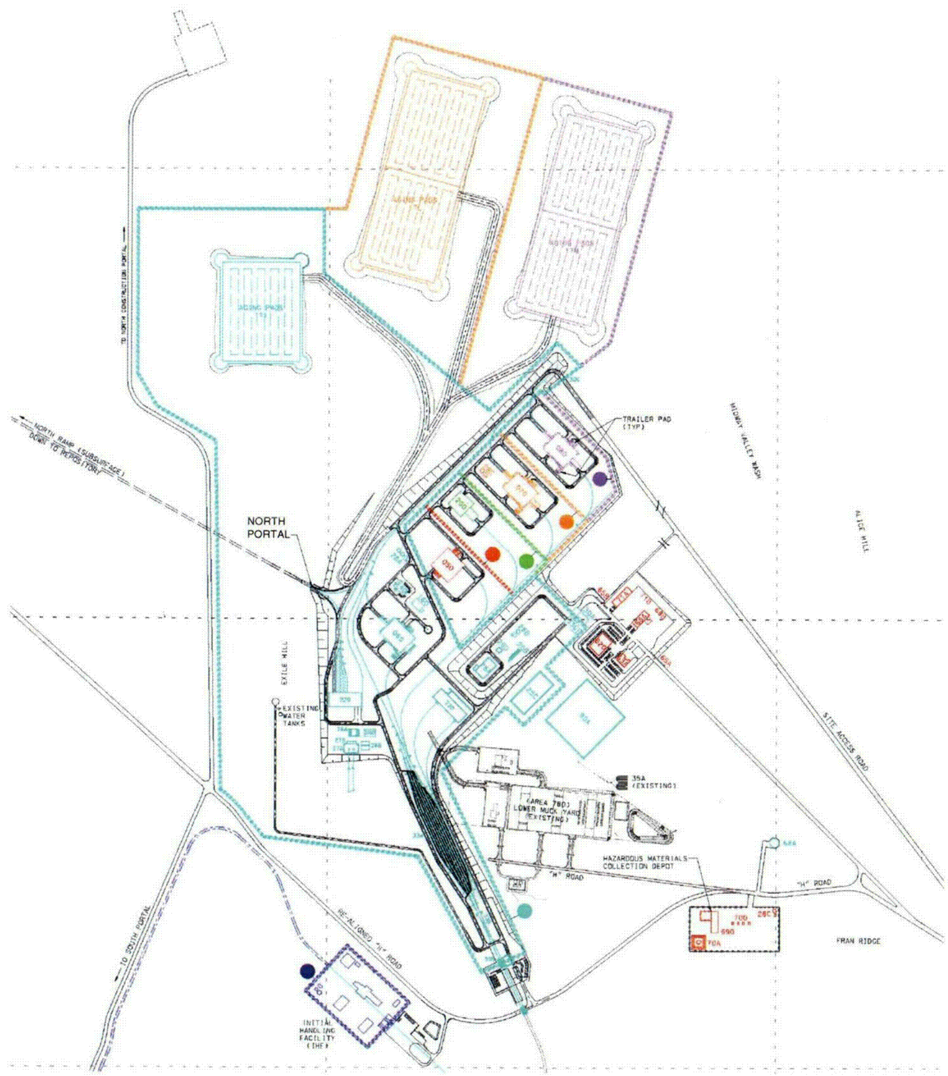
Functional Matrix

	Feature \ Facility		Initial Handling Facility (IHF)	Canister Receipt and Closure Facility (CRCF)	Wet Handling Facility (WHF)	Receipt Facility (RF)
Waste Form	HLW	Canister	X	X	-	-
	Naval SNF	Canister	X	-	-	-
	DOE SNF	Canister	-	X	-	-
	CSNF	Uncanistered	-	-	X	-
	CSNF	TAD	-	X	X	X
	Phase 1					
	Phase 2					
	Phase 3					
Key Features	WP Loading and Closure		X	X	-	-
	ITS Seismic Structure		X	X	X	X
	ITS Mechanical handling		X	X	X	X
	ITS Confinement		-	X	X	X
	ITS HEPA Exhaust		-	X	X	X
	ITS Emergency Power		-	X	X	X
	Remediation capability		Dry	Dry	Wet	Dry

Note: Phases 4 and 5 add CRCF-2 and CRCF-3, respectively

Site Layout

Site Overview



LEGEND

AREA No.	DESCRIPTION
-	WASTE PACKAGE RECEIPT FACILITY (150 COMBINED WITH 230)
050	WET HANDLING FACILITY (WHF)
060	CANISTER RECEIPT AND CLOSURE FACILITY 1 (CRCF 1)
070	CANISTER RECEIPT AND CLOSURE FACILITY 2 (CRCF 2)
080	CANISTER RECEIPT AND CLOSURE FACILITY 3 (CRCF 3)
110	DRY TRANSFER FACILITY #1 (DTF-1) - REMOVED
120	DRY TRANSFER FACILITY #2 (DTF-2) - REMOVED
130	REMEDIATION FACILITY (RF) - REMOVED
14A	TRANSPORTATION CASK RECEIPT/RETURN FACILITY (TCRRF) - REMOVED
14B	TRANSPORTATION CASK BUFFER AREA - REMOVED
160	LOW LEVEL WASTE HANDLING (LLWH)
17A-17J	AGING PADS - REMOVED
17K	AGING PADS (500 SPACES)
17L	AGING PADS (1000 SPACES)
17M	AGING PADS (1000 SPACES)
200	RECEIPT FACILITY (RF)
220	HEAVY EQUIPMENT MAINTENANCE FACILITY (HEMF)
230	WAREHOUSE & NON-NUCLEAR RECEIPT FACILITY (WNNRF)
240	CENTRAL CONTROL CENTER FACILITY (CCCF)
25A	UTILITIES FACILITY (UF)
25B	COOLING TOWER
25C	EVAPORATION POND
25D	SERVICE GASES STORAGE AREA
26A	4.16KV SWITCHGEAR FACILITY
26B	STANDBY GENERATOR FACILITY
26D	EMERGENCY DIESEL GENERATOR FACILITY (EDG)
27A	SWITCHYARD (230KV & 138KV)
27B	12.47KV SWITCHGEAR FACILITY
28A	FIREWATER FACILITY (CENTRAL)
28B	FIREWATER FACILITY (SOUTH)
28C	FIREWATER FACILITY (EAST)
28D	FIREWATER FACILITY (WEST) - REMOVED
28E	FIREWATER FACILITY (NORTH)
30A	CENTRAL SECURITY STATION
30B	CASK RECEIPT SECURITY STATION
30C	NORTH PERIMETER SECURITY STATION
33A	RAIL CAR STAGING AREA
33B	TRUCK STAGING AREA
33C	BUS STAGING AREA
35A	SEPTIC TANK AND LEACH FIELD - EXISTING
620	ADMINISTRATION FACILITY
63A	FIRE, RESCUE & MEDICAL FACILITY (OPERATIONS)
63B	FIRE, RESCUE & MEDICAL FACILITY (CONSTRUCTION / REMOTE)- REMOVED
65A	ADMINISTRATION SECURITY STATION (SOUTH)
65B	ADMINISTRATION SECURITY STATION (NORTH)
66A	HELICOPTER PAD (OPERATIONS)
66B	HELICOPTER PAD (CONSTRUCTION/REMOTE) - REMOVED
68A	WAREHOUSE/CENTRAL RECEIVING
68B	MATERIALS/YARD STORAGE
690	VEHICLE MAINTENANCE AND MOTOR POOL
700	FUEL DEPOT
70A	DIESEL FUEL OIL STORAGE
71A	CRAFT SHOPS
71B	EQUIPMENT/YARD STORAGE
780	LOWER MUCK YARD (LMY) - EXISTING
90A	STORM WATER RETENTION POND

EXISTING
FENCE
FUTURE
OVERHEAD POWER LINE
ROAD
SECURITY FENCE
RAILROAD
CONTOURS

NOTES:

1. RAILROAD ALIGNMENT SHOWN IS CONCEPTUAL.
2. ROAD ALIGNMENT SHOWN IS CONCEPTUAL AND IS SUBJECT TO CHANGE AS THE FACILITY DESIGN DEVELOPS.
3. LOWER MUCK YARD SHOWN FOR REFERENCE ONLY (EXISTING).
4. FACILITY SIZES AND LOCATIONS SHOWN ON THIS DRAWING ARE APPROXIMATE AND SUBJECT TO CHANGE BASED ON DESIGN DEVELOPMENT.

INITIAL HANDLING OPERATION AREA
CRCF 1 OPERATIONS AREA
WET HANDLING FACILITY (WHF) OPERATIONS AREA ADDITION
RECEIPT FACILITY OPERATIONS AREA ADDITION
CRCF 2 OPERATIONS AREA ADDITION
CRCF 3 OPERATIONS AREA ADDITION

C-01

Site Layout Changes

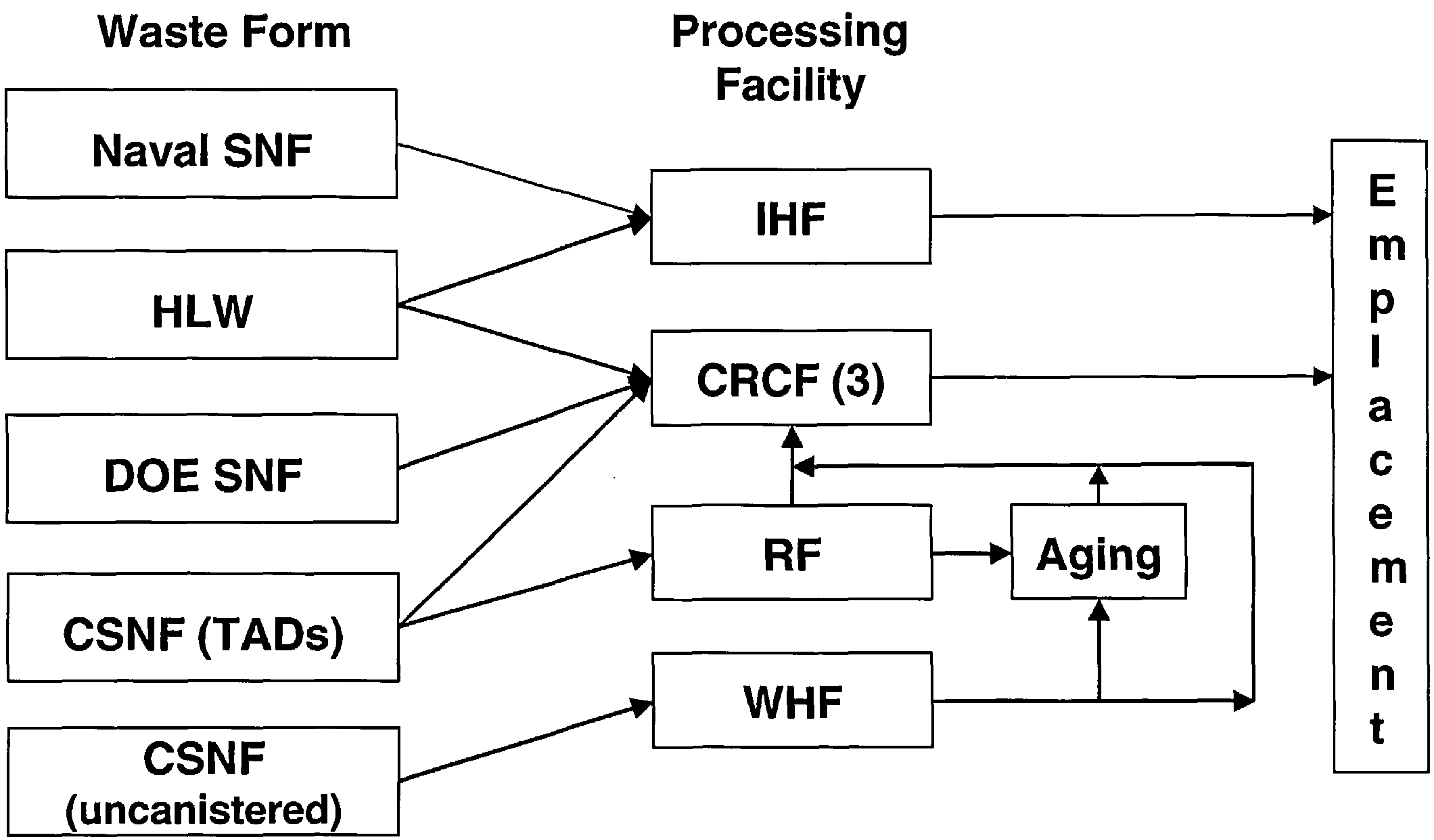
- Waste handling, aging, and support facilities in same general location as previous layout
- Added IHF adjacent to main facility area
- IHF allows canisterized waste (HLW and Naval SNF) receipt and emplacement with minimal impact to construction of other waste handling facilities

Waste Handling Process

Waste Handling Changes

- TAD canister eliminates majority of individual CSNF assembly handling at repository
- Remaining uncanistered individual CSNF assemblies handled wet

Waste Form Processing Overview



Waste Package and TAD

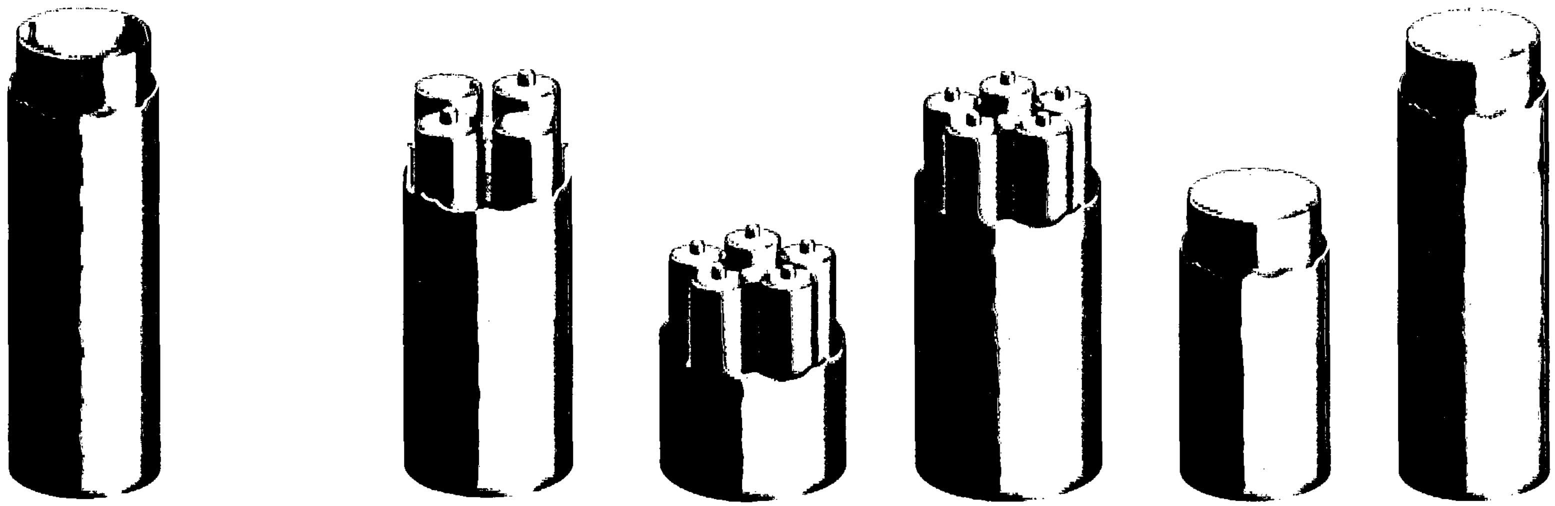
Waste Package and TAD Changes

- Utilize TAD canisters for majority of individual CSNF assemblies
- TADs reduce Waste Package configuration suite from 10 to 6
- Shield plugs added to Waste Packages used for HLW and DOE SNF

TAD Key Features

- Majority of individual CSNF assembly transfers to load TADs performed by utility operators experienced with their SNF
- Some TADs loaded at repository
- Significantly reduces individual CSNF assembly handling at repository
- Simplifies repository design and operations
- Reduces risk at repository
- TADs include shield plugs
- NRC letter of August 10, 2006, on TADs

Waste Package Configuration Suite



TAD
21-PWR
44-BWR

Shield plugs are integral to canister design

2-MCO 2-DHLW Long | **5-DHLW/DOE SNF Short** | **5-DHLW/DOE SNF Long**

Shield plugs added to waste package design

Naval SNF Short | **Naval SNF Long**

Shield plugs are integral to canister design

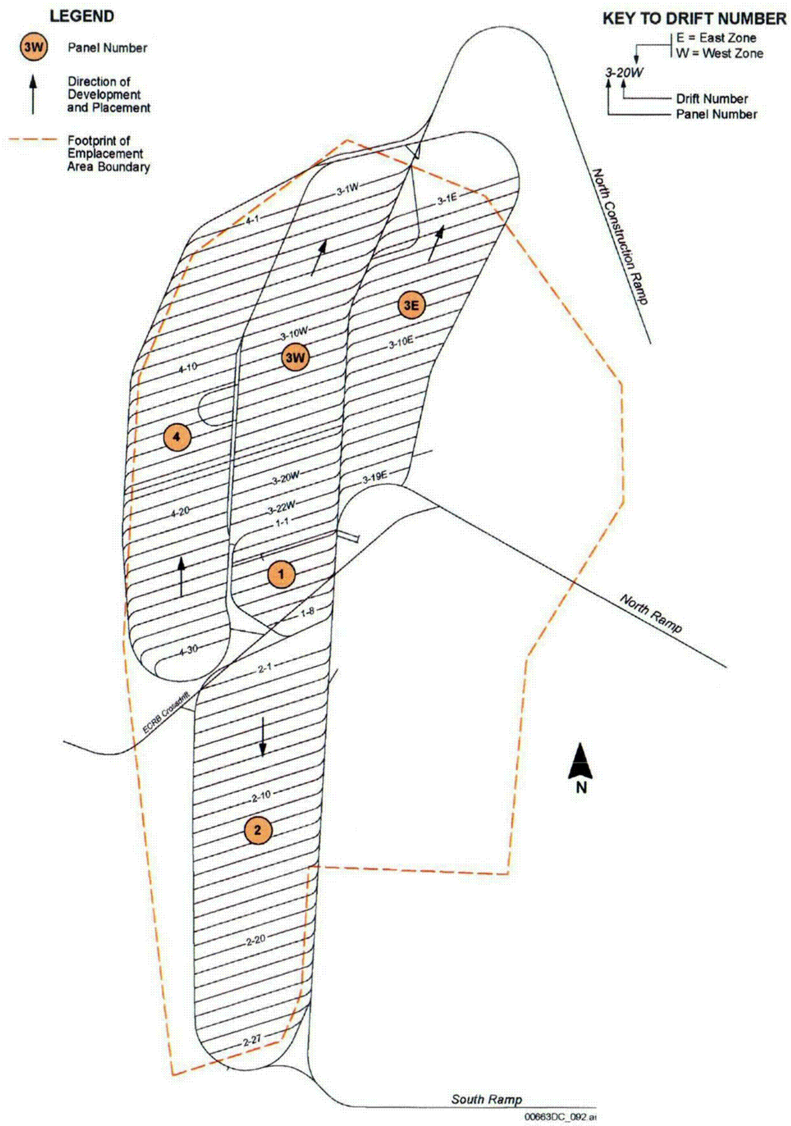
Subsurface

Subsurface Changes

- No changes in overall emplacement concept
- Minor changes in layout

Phased Construction and Operation

Subsurface Layout



Emplacement Sequence:

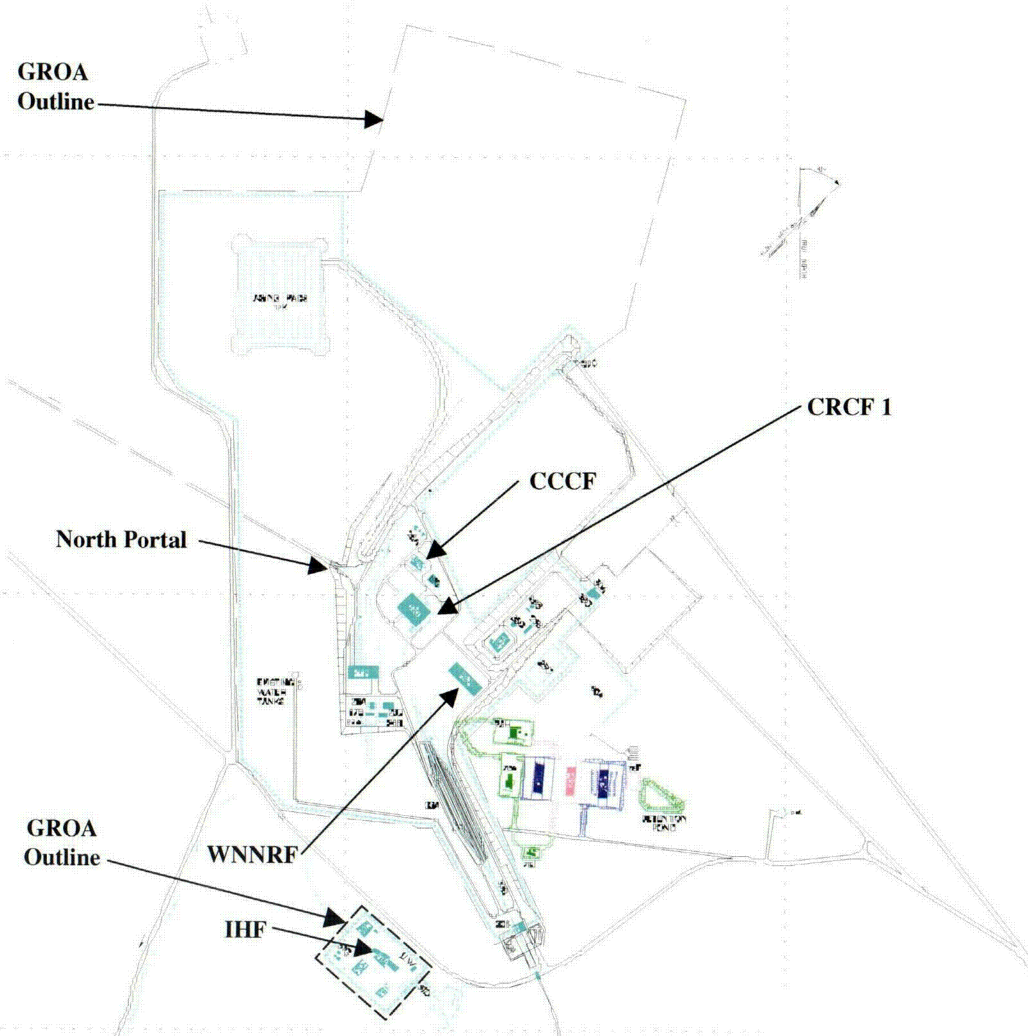
- Panel 1, 8 drifts
- Panel 2, 17 drifts
- Panel 3E & 3W, 41 drifts
- Panel 4, 30 drifts

C-02

Phased Construction and Operation

- Five phases designed to facilitate waste receipt and emplacement
- Step-wise approach to construction to benefit from lessons learned
- No adverse impact on waste handling and emplacement operations from construction activities
- Security, monitoring, emergency power, etc. adjust as new phases come on-line

Phase 1 Construction



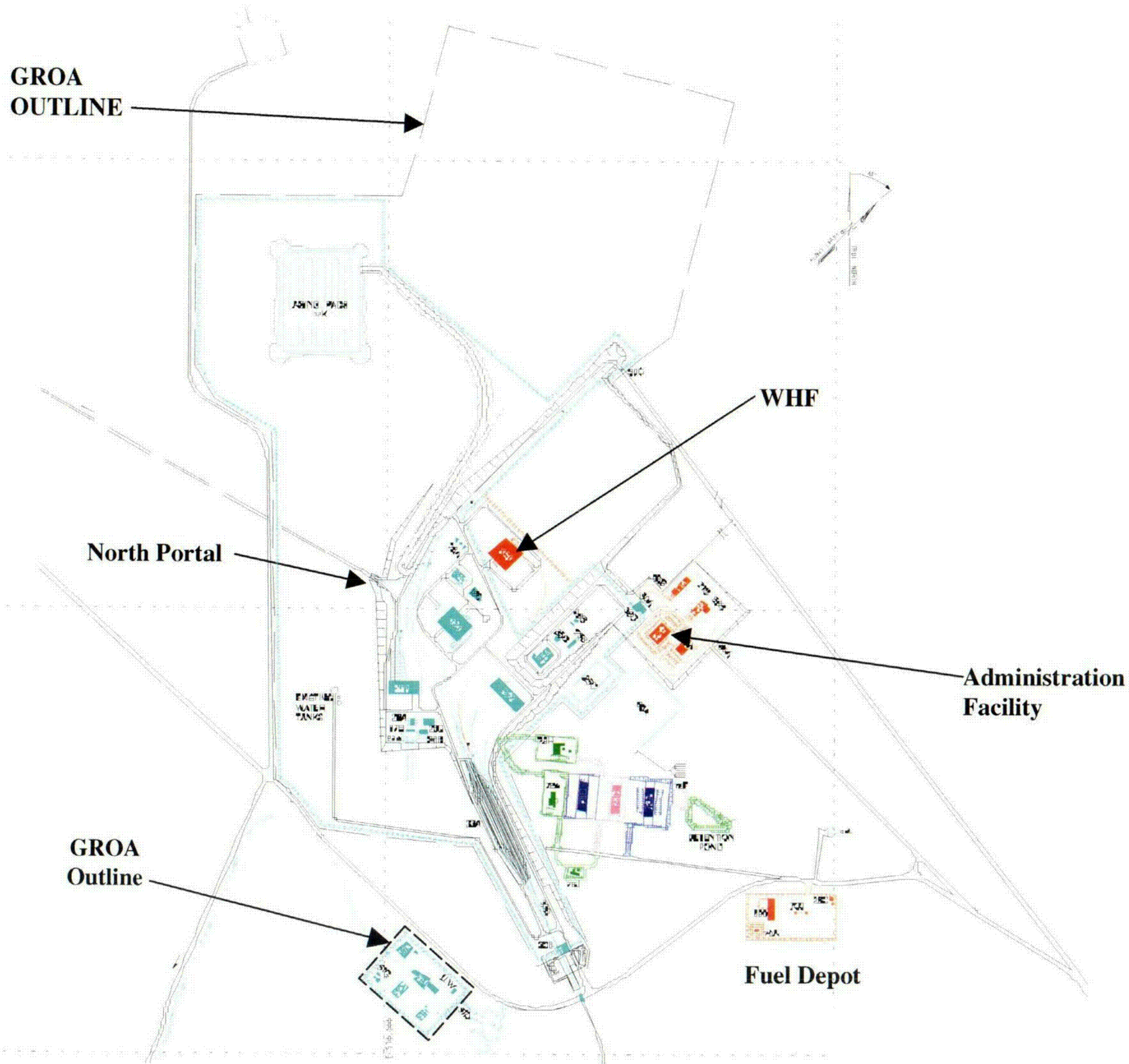
Phase 1 Construction

Operations Area

51A	Initial Handling Facility
51B	Central Control Facility
51C	Warehouse
51D	Truck Staging
51E	Cask Receipt Security Station
51F	Transporter Security Gate
51G	Utility Facility
51H	Storm Water Detention Pond
51J	Septic Tank and Leach Field
51K	Substation
51L	Standby Diesel Generator
060	Canister Receipt and Closure Facility 1
•	Low Level Waste Handling
17K	Aging Pad
220	Heavy Equipment Maintenance Facility
•	Warehouse and Non-Nuclear Receipt Facility
•	Central Control Center Facility
25A	Utilities Facility
25B	Cooling Tower
25C	Evaporation Pond
25D	Service Gases Storage Area
26A	4.16kV Switchgear Facility
26B	Standby Generator Facility
26D	Emergency Diesel Generator Facility
27A	Switchyard
27B	12.47 kV Switchgear Facility
28A	Firewater Facility (Central)
28B	Firewater Facility (South)
30A	Central Security Station
30C	North Perimeter Security Station
33A	Rail Car Buffer Area
33B	Truck Buffer Area
33C	Bus Buffer Area
66A	Helicopter Pad (Operations)
90A	Storm Water Detention Pond

C-03

Phase 2 Construction



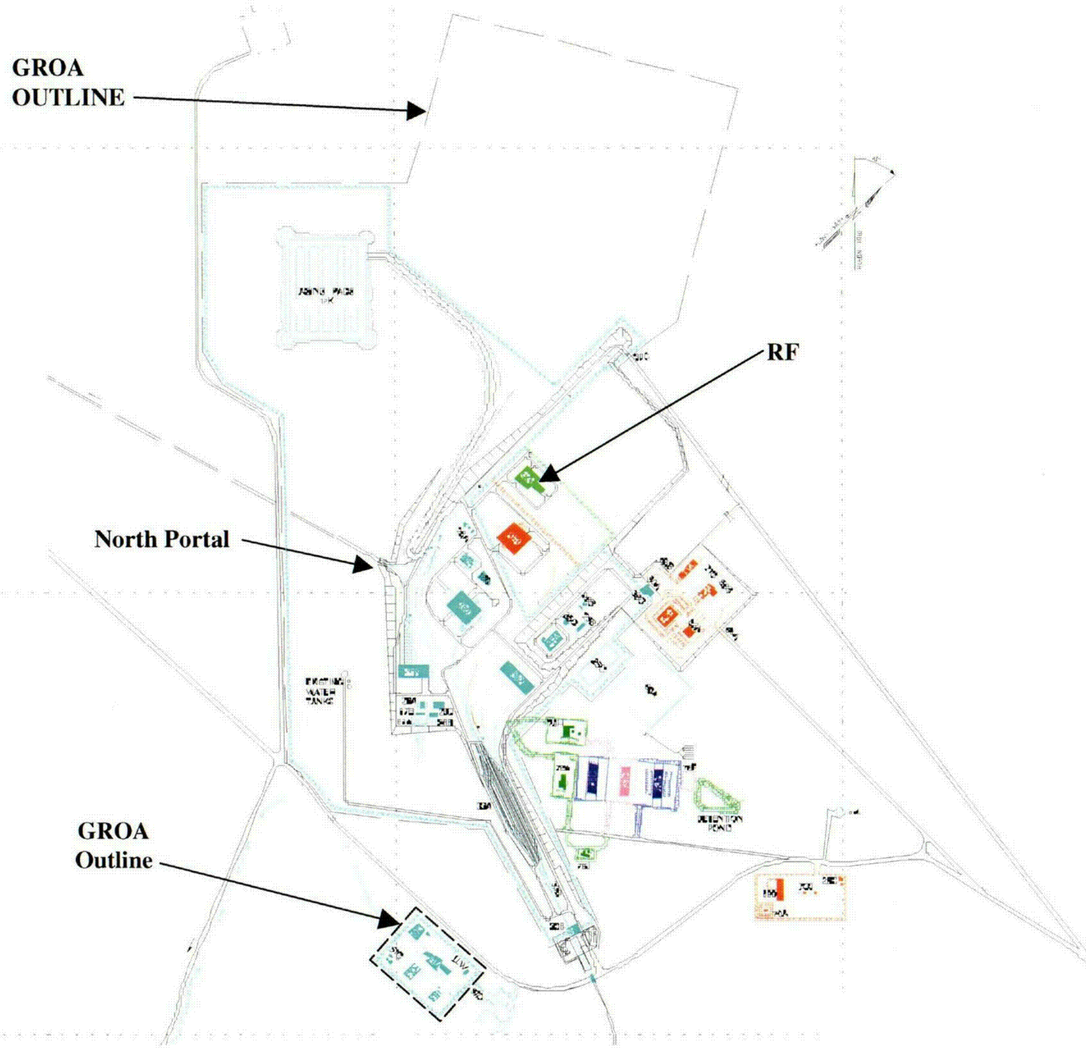
Phase 2 Construction

Operations Area

050	Wet Handling Facility
28C	Firewater Facility (East)
620	Administration Facility
63A	Fire, Rescue & Medical Facility (Operations)
65A	Administration Security Station (South)
65B	Administration Security Station (North)
68A	Warehouse/Central Receiving
68B	Materials/Yard Storage
690	Vehicle Maintenance and Motor Pool
•	Fuel Depot
70A	Diesel Fuel Oil Storage
71A	Craft Shops
71B	Equipment/Yard Storage

C-04

Phase 3 Construction



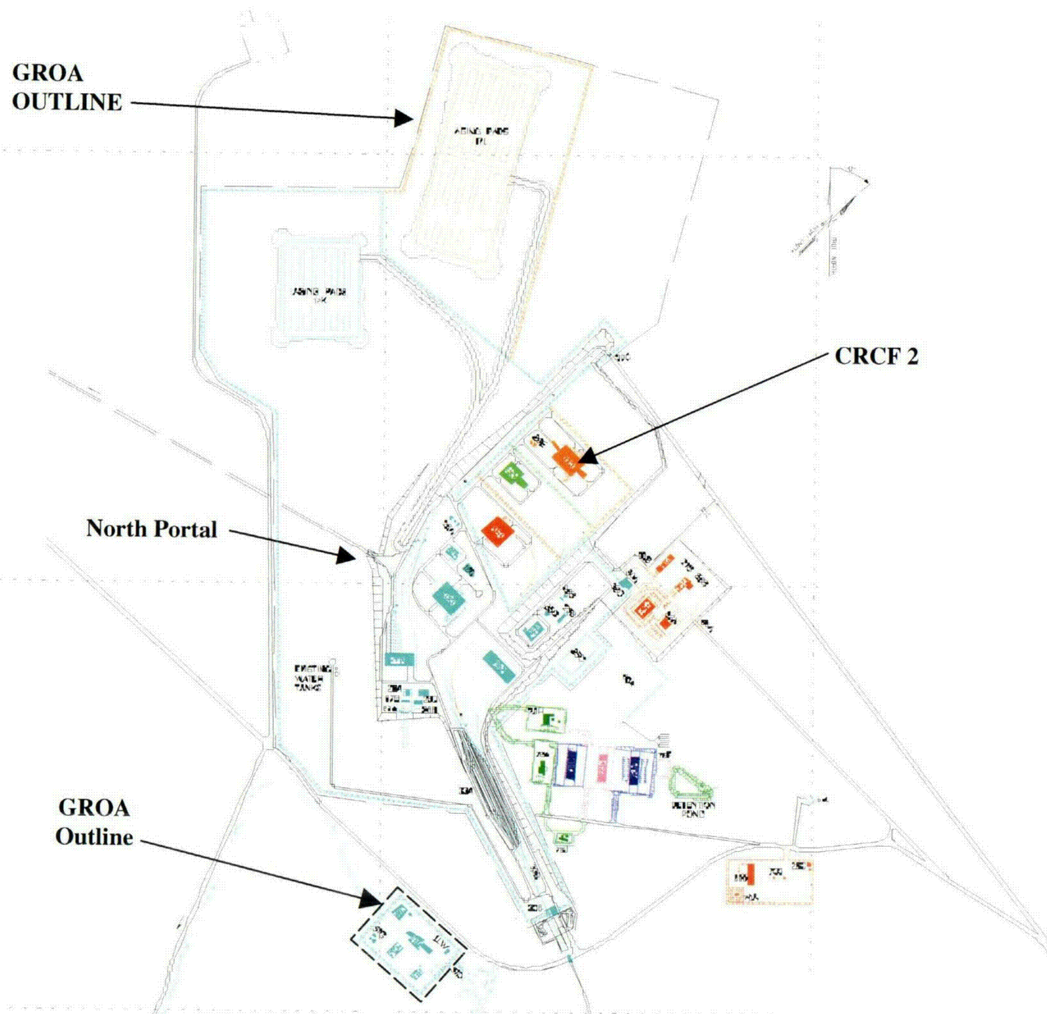
Phase 3 Construction

Operations Area

200 Receipt Facility

C-05

Phase 4 Construction



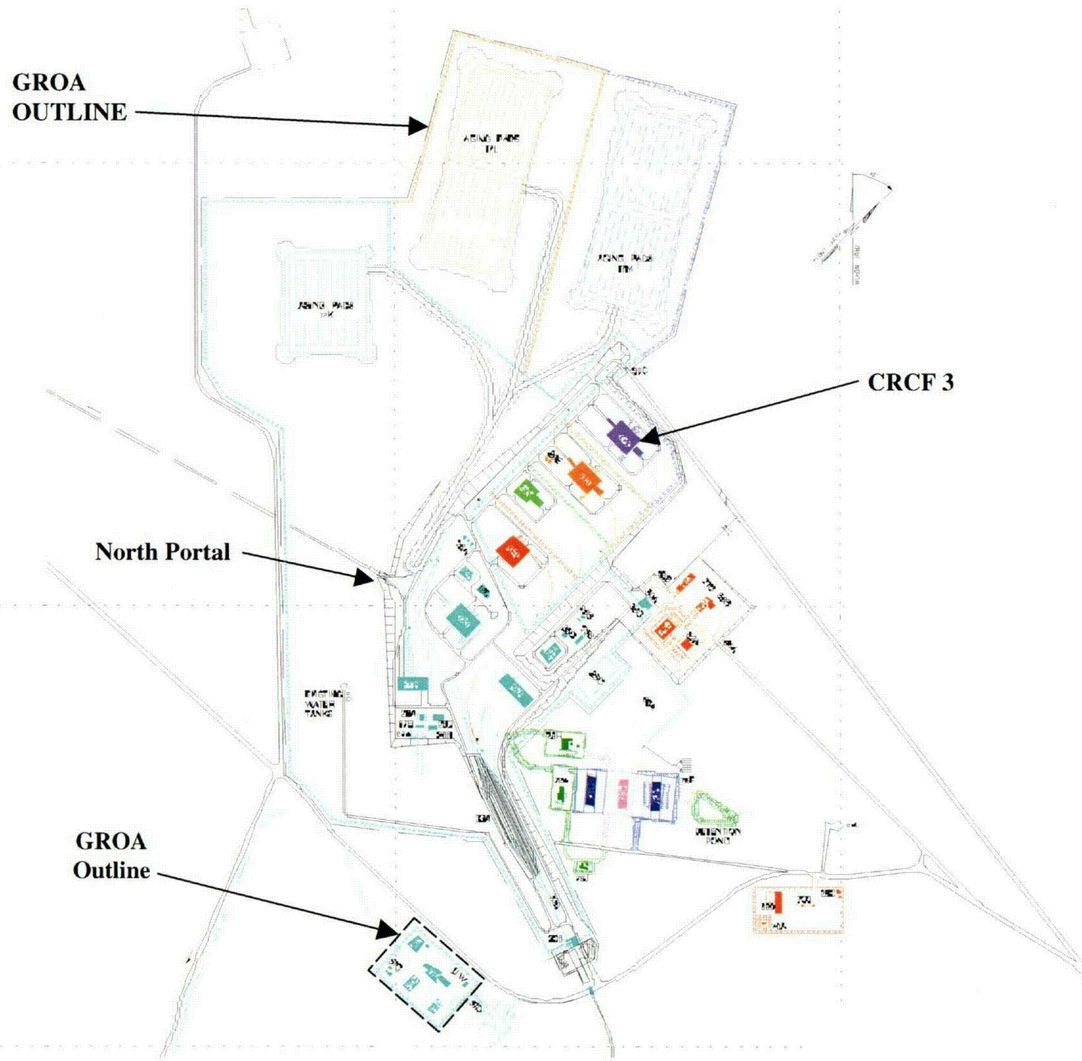
Phase 4 Construction

Operations Area

070	Canister Receipt and Closure Facility 2
17L	Aging Pad
28E	Firewater Facility (North)

C-06

Phase 5 Construction



Phase 5 Construction

Operations Area

080	Canister Receipt and Closure Facility 3
17M	Aging Pad

C-07

Summary of Design Changes Approved Through DOE's CD-1 Process

- Use of TADs simplifies waste handling
- Operational goal of 90% of individual CSNF assemblies loaded in TADs by utilities
- Wet handling of remaining individual uncanistered CSNF assemblies
- Waste Package configuration suite simplified

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Surface Facilities Overview and Canister Receipt and Closure Facility

Presented to:
NRC/DOE Technical Exchange and Management Meeting on Design Changes Approved Through DOE's Critical Decision-1 (CD-1) Process

Presented by:
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August 29, 2006
Las Vegas, Nevada

Acronyms

ALARA	As Low As Reasonably Achievable
BWR	Boiling Water Reactor
CD-1	Critical Decision - 1
CRCF	Canister Receipt and Closure Facility
CSNF	Commercial Spent Nuclear Fuel
DHLW	Defense High Level Waste
GROA	Geologic Repository Operations Area
GWd	Gigawatt Day
HEPA	High Efficiency Particulate Air (filter)
HVAC	Heating, Ventilation, and Air-Conditioning
IHF	Initial Handling Facility
ITS	Important to Safety
MCO	Multi-Canister Overpack
MTHM	Metric Tons of Heavy Metal
PHA	Preliminary Hazards Analysis
PWR	Pressurized Water Reactor
RF	Receipt Facility
SSC	Structures, Systems, and Components
TAD	Transport, Aging, and Disposal Canister
TEDE	Total Effective Dose Equivalent
WHF	Wet Handling Facility

Technical Requirements

Unchanged by CD-1 Process:

- Facilities designed to protect against internal and external hazards
- Facilities designed to prevent or mitigate event sequences
- Limit CSNF cladding temperature to 400°C for normal conditions and 570°C for off-normal events
- Prevent oxidation of individual CSNF assemblies received with breached cladding
- Prevent criticality by moderator exclusion and physical configuration
- Remote waste package closure system

Technical Requirements (cont.)

Changed by CD-1 Process:

- Shielded handling operations to the extent possible to facilitate hands-on maintenance and off-normal event recovery
- TADs (all-canister approach) allow for local confinement of radioactive sources rather than allowing contamination to spread in waste handling areas
- Added the requirement for CSNF to be placed into TADs, welding (closure) of TADs, and then placement of the TADs into Waste Packages

Overview of Hazards Evaluation

PHA performed as part of CD-1:

- Integrated Safety Management Evaluation
- Preclosure hazards:
  - External and internal hazards for surface and subsurface facilities
- Postclosure hazards
- Also addressed:
  - ALARA considerations
  - Construction hazards
  - Operational hazards

PHA Overview

Objective		Conceptual Design
• Reduce number of fuel assembly handlings	⇒	• Operational goal of 90% of CSNF in TADs
• Reduce handling of fuel assemblies in air	⇒	• Uncanistered CSNF assemblies transferred in WHF pool
• Minimize number of lifts	⇒	• Overall CSNF lifts reduced by a factor of about 20
• Reduce number of event sequences	⇒	• No Category 1 event sequences identified based on conceptual design

PHA Methodology

- Internal and external hazards identified:
  - Industry guidelines
  - Previous studies
  - CD-1 design changes
- Event sequence frequency estimates based on facility operations
- Event sequence categorization (Category 1, 2, or Beyond Category 2) based on frequency estimates
- Preliminary ITS structures, systems, and components identified
- Preliminary dose estimates for identified event sequences

Hazard Identification

- **External Events considered include:**
  - Extreme weather and climate fluctuations
  - Extreme wind and tornado
  - Aircraft
  - Flooding and rainstorm
  - Seismic activity – earthquake
  - Seismic activity – fault displacement
  - Loss of offsite power
  - Sandstorm
  - Range fire
  - Lightning
- **Internal Events identified using generic hazards list based on established hazard evaluation techniques**

Key Assumptions: Radiological Consequence Analysis

- Source Terms
  - Use of bounding source terms (e.g., 80 GWd/MTHM, 5-year cooling time, 5% initial enrichment for PWR spent fuel) for all LWR assemblies
  - Assumption of 100% cladding breach after a transportation cask, dual purpose canister, TAD drop event
  - Assumption of 1% fuel clad defects for as received CSNF
  - No credit for building retention of released particulates
  - Assumption of maximum annual throughput for each year of operation
  - Assumption of HEPA filter efficiency of 99% per stage (HEPA filters have been tested to an efficiency of 99.97%)
  - Assumption of aging pads at full capacity (21,000 MTHM)

Key Assumptions: Radiological Consequence Analysis (cont.)

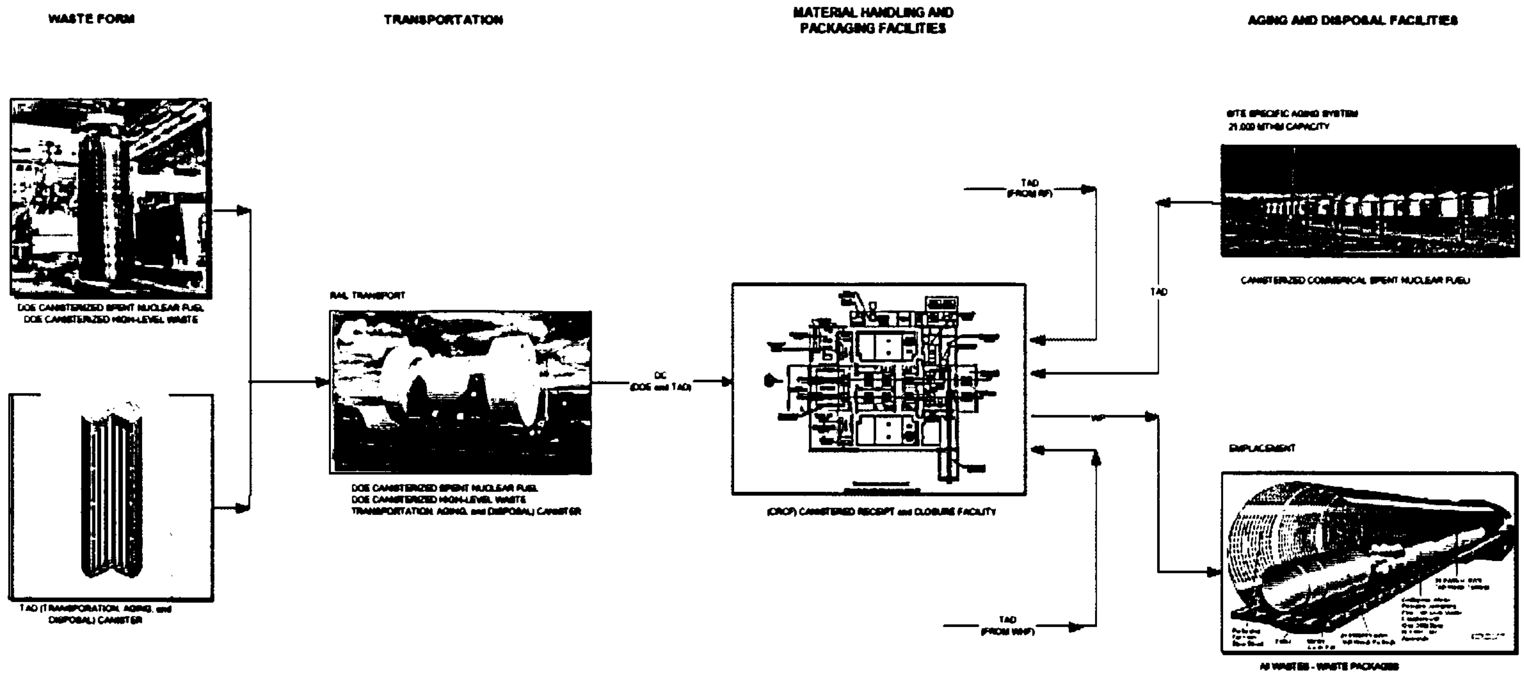
- Site Weather
  - Use of maximum sector 95th percentile χ/Q values
  - Assumption of a 1-month release period
  - Operating releases
- Worker, Onsite/Offsite Public
  - Assumption of no post-accident protective measures for offsite and onsite members of the public
  - Assumption of 100% occupancy at 100 m for onsite public
  - Assumption of 100% occupancy at nearest site boundary location
  - Assumption of no evacuation for facility workers
  - Assumption of 100% locally grown food for offsite public ingestion pathway

Key Assumptions: Potential Doses Resulting from TAD Drop and Breach

- TAD contains 21 PWR or 44 BWR assemblies
- CSNF isotopic fractions available for release based on Interim Staff Guidance – 5 (ISG-5)
- CSNF clad unzipping begins two hours after TAD is postulated to breach
- CSNF fully oxidized to U_3O_8 powder in 30 days
- Oxidized CSNF release fractions based on *Commercial Spent Nuclear Fuel Handling in Air Study* (March 2005)

CRCF Concept of Operations

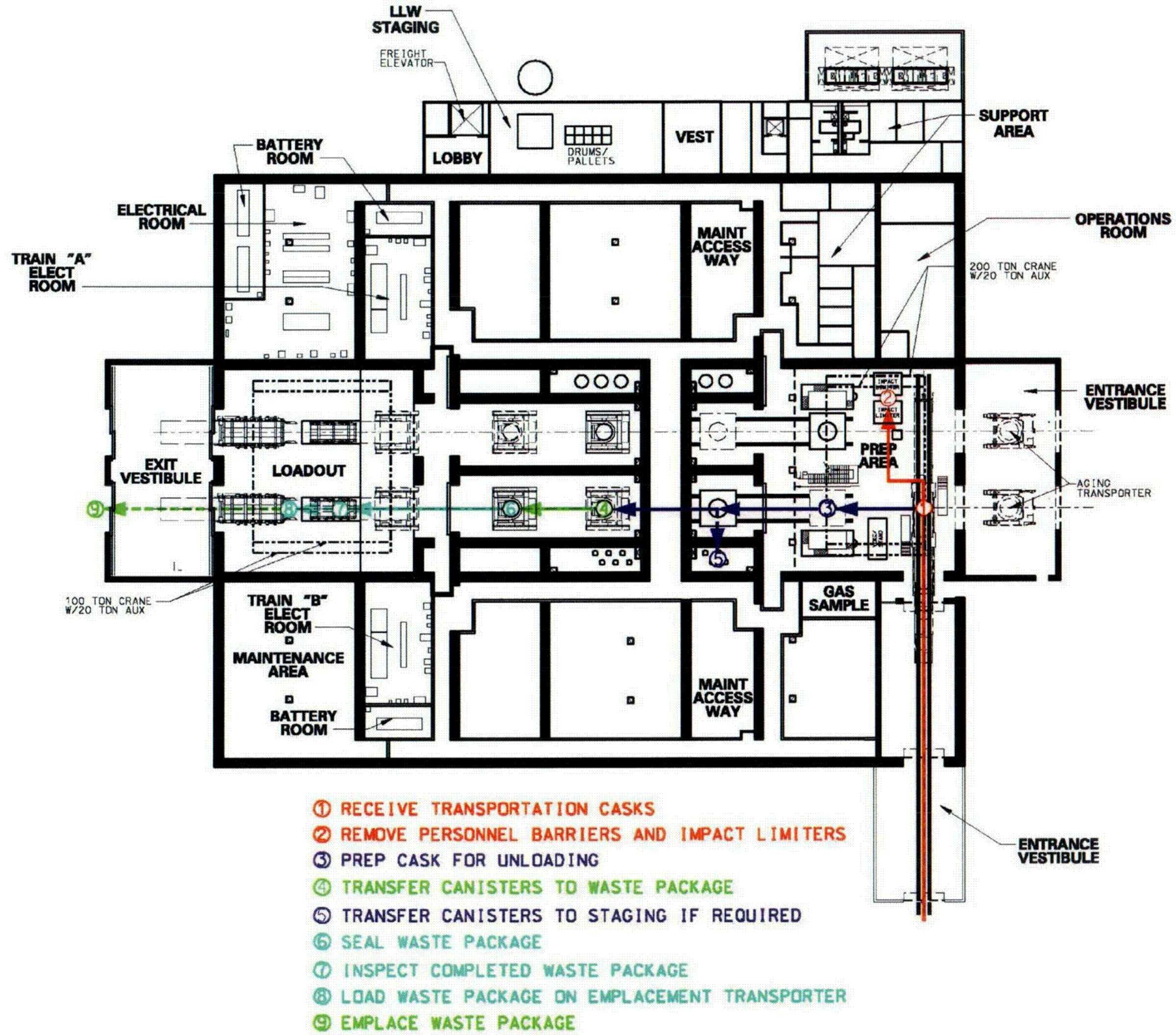
CONCEPT of OPERATIONS - CANISTER RECEIPT and CLOSURE FACILITY (CRCF)



CRCF Key Features

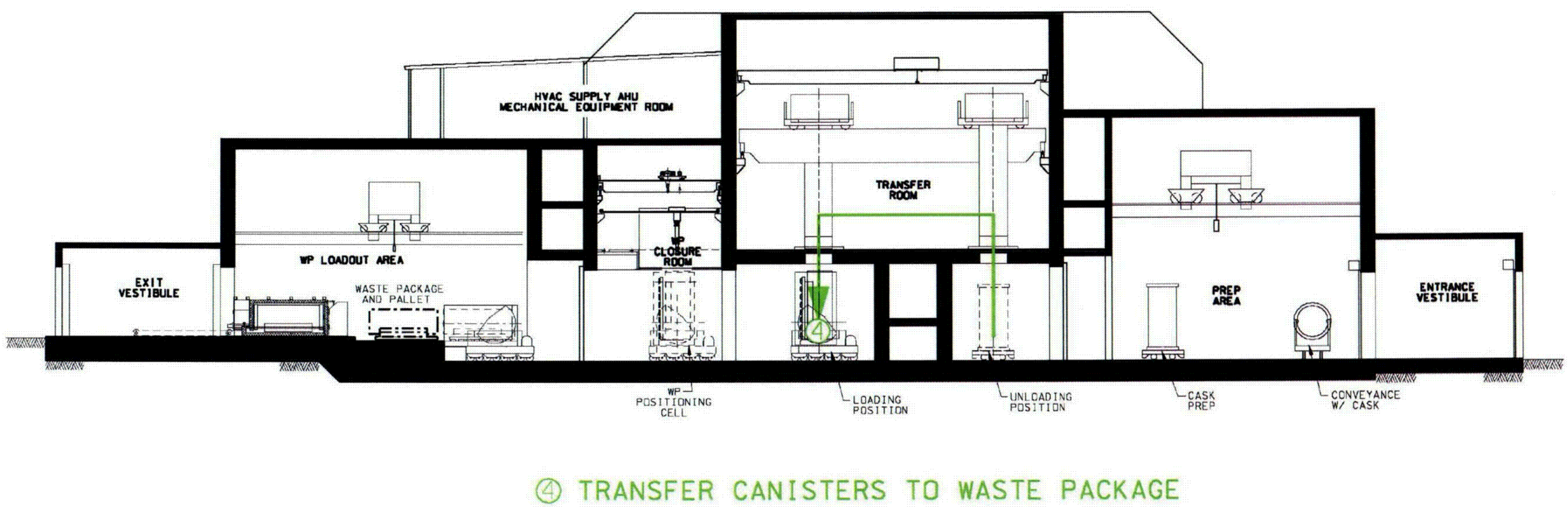
- Receives transportation and shielded transfer casks and aging overpacks
- Production facility for loading and closing waste packages
- Prevents and mitigates Category 2 event sequences involving cask / canister drop
- ITS confinement
- ITS HEPA filtered exhaust system
- ITS electrical system, including remotely located emergency diesel generators
- ITS seismic concrete structure with steel vestibules
- ITS mechanical handling
  - Cask trolley
  - Cask handling crane
  - Canister transfer machine
  - Waste package trolley

CRCF Layout



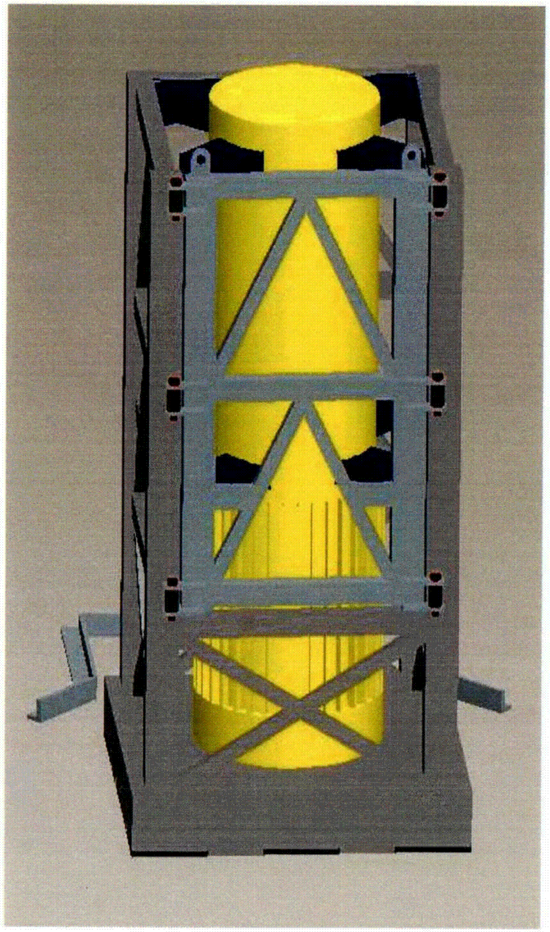
C-08

CRCF Layout



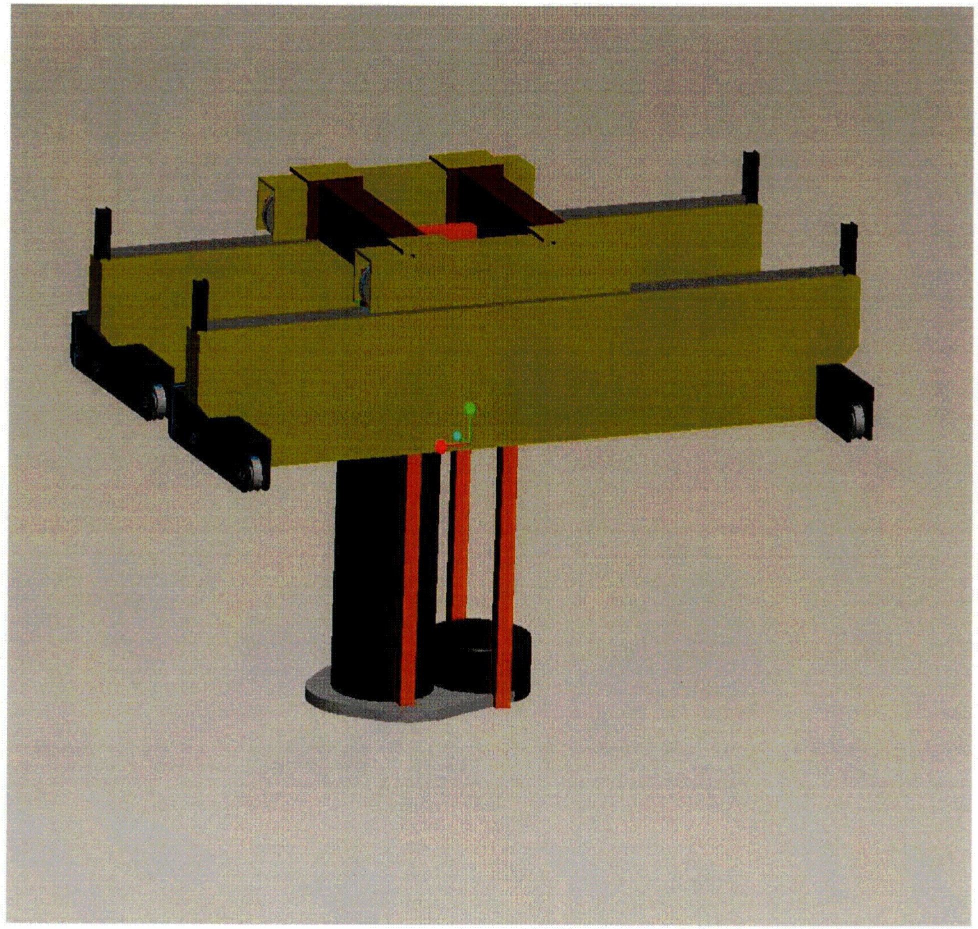
C-09

Cask Trolley



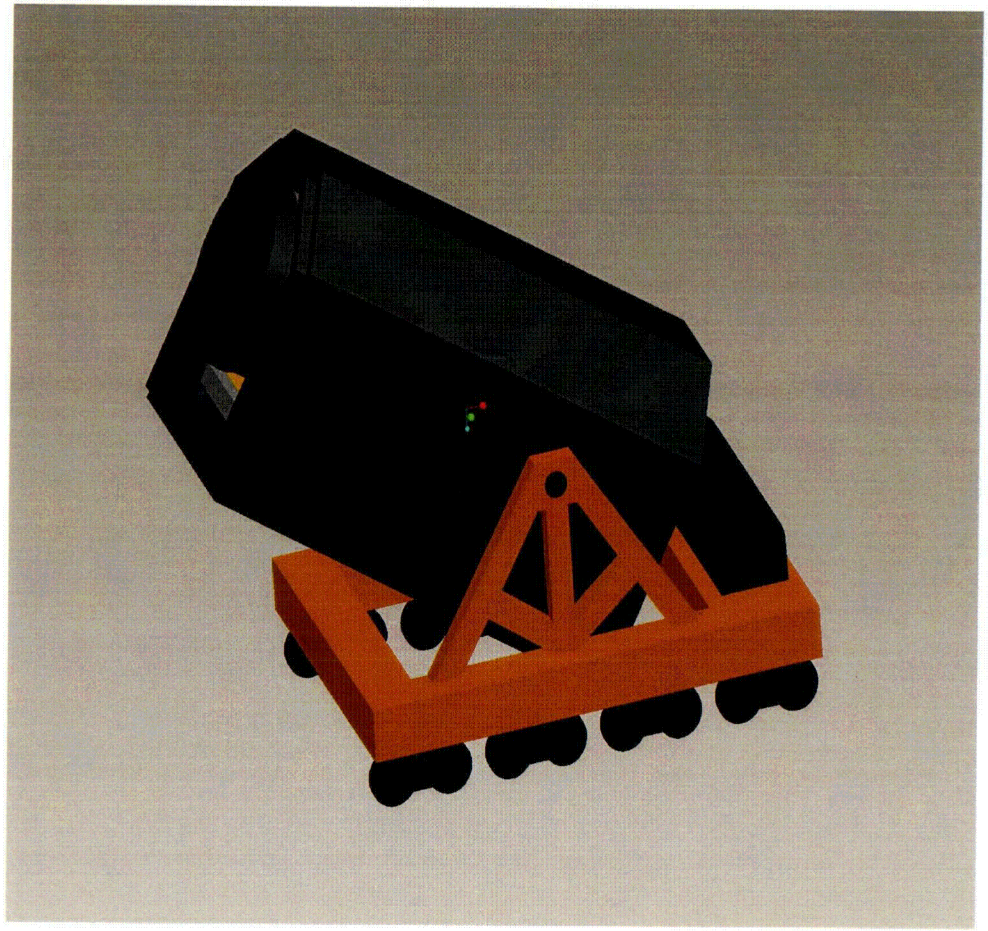
C-10

Canister Transfer Machine



C-15

Waste Package Trolley



C-12

Example 1: CRCF Event Sequence

- **Drop and breach of a TAD:**

  (Transfer from a transportation cask to a waste package using the canister transfer machine)

  – Canister transfer machine drop rate 1×10^{-5} drops per lift

  – Category 2 event sequence

  – Material at risk is 1 TAD holding 21 PWR or 44 BWR assemblies

  – Assumed cladding failure with radionuclide releases due to canister drop and fuel oxidation

  – Redundant ITS HVAC exhaust system with HEPA filtered releases

Example 2: CRCF Event Sequence

- **Drop and breach of a transportation cask:**
  (Impact limiters removed with HLW canisters inside during transfer of cask from its conveyance to a cask trolley using the overhead cask handling crane)
  - Overhead crane drop rate 1×10^{-5} drops per lift
  - Category 2 event sequence
  - Material at risk is 5 HLW canister

CRCF PHA Results

- No Category 1 Event Sequences
- Bounding Category 2 event sequence (drop and breach of TAD) TEDE offsite dose is << 5 rem
- SSCs identified as candidates for Important-to-Safety
  - Building (e.g., designed for confinement, seismic, high wind/tornado/tornado missiles)
  - Cask handling crane
  - Canister transfer machine
  - Cask and waste package trolleys
  - HVAC exhaust system with HEPA filtration
  - Electrical power to HVAC exhaust system

U.S. Department of Energy

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

Surface Facilities – Initial Handling Facility, Wet Handling Facility, and Receipt Facility

Presented to:

NRC/DOE Technical Exchange and Management Meeting on Design Changes Approved Through DOE's Critical Decision-1 (CD-1) Process

Presented by:

David Tooker - Nuclear Facilities Project Engineer

Tom Dunn - Preclosure Safety Hazards Analysis Supervisor

Bechtel SAIC Company, LLC

August 29, 2006

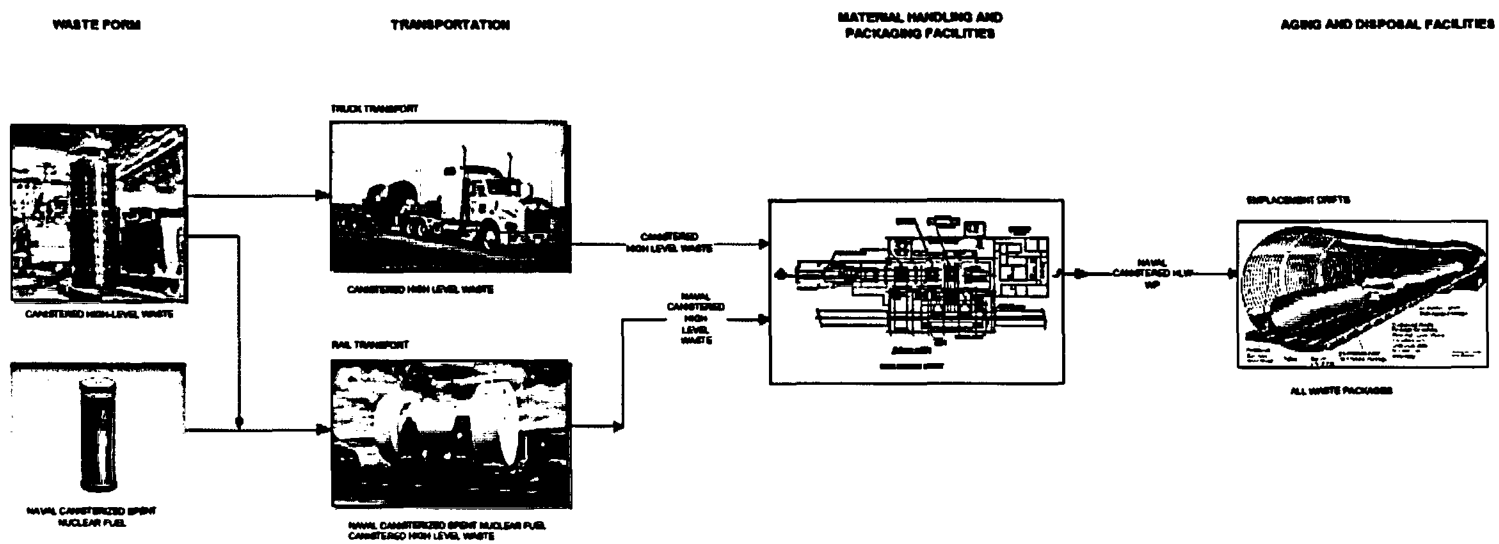
Las Vegas, Nevada

Acronyms

ALARA	As Low As Reasonably Achievable
CD-1	Critical Decision - 1
CRCF	Canister Receipt and Closure Facility
CSNF	(Commercial) Spent Nuclear Fuel
DHLW	(Defense) High Level Waste
DPC	Dual Purpose Container
GROA	Geologic Repository Operations Area
HEPA	High Efficiency Particulate Air (filter)
HVAC	Heating, Ventilation and Air-Conditioning
IHF	Initial Handling Facility
ITS	Important to Safety
MCO	Multi-Canister Overpack
PHA	Preliminary Hazards Analysis
PWR	Pressurized Water Reactor
mrem	(milli) Roentgen Equivalent Man
RF	Receipt Facility
SSC	Structures, Systems, and Components
TAD	Transport, Aging, and Disposal Canister
TEDE	Total Effective Dose Equivalent
WHF	Wet Handling Facility
WP	Waste Package

IHF Concept of Operations

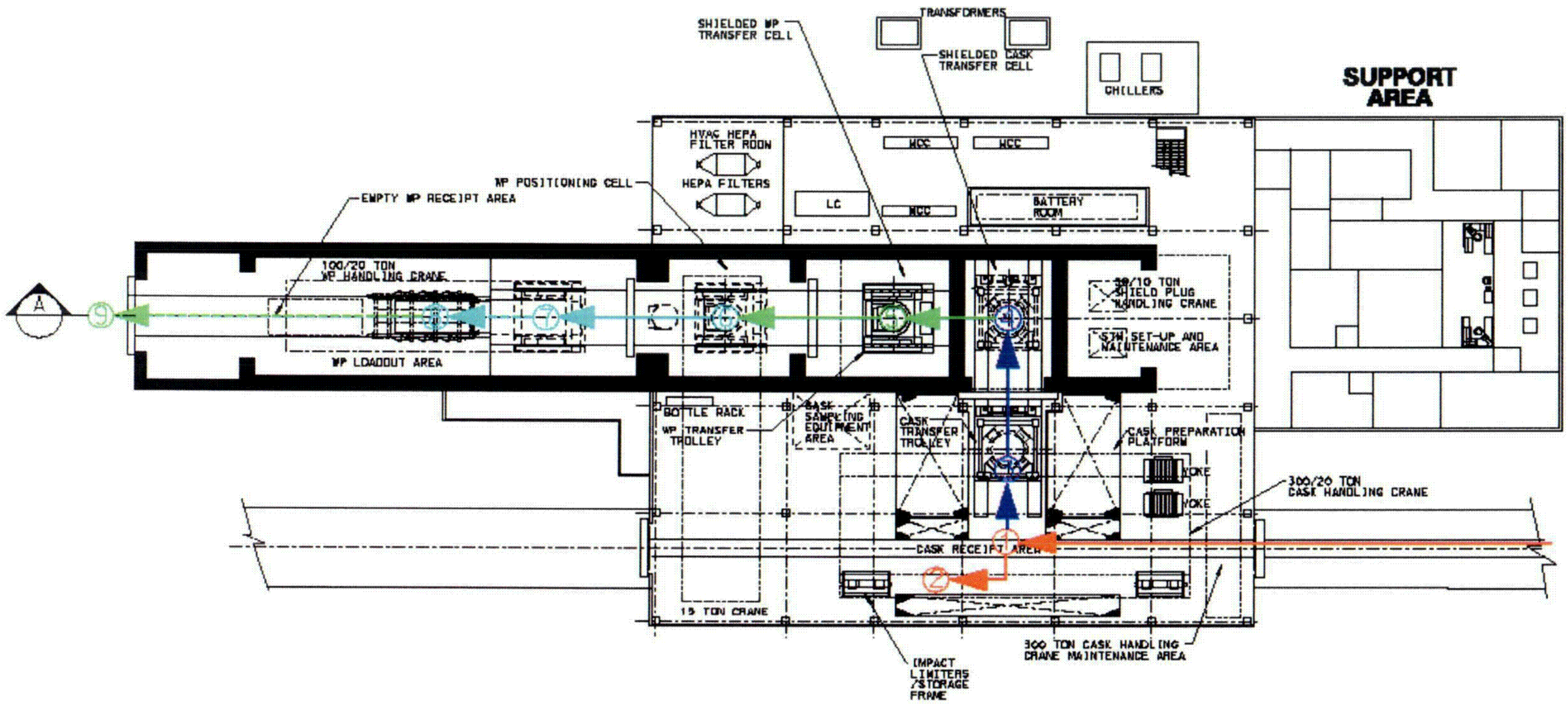
CONCEPT of OPERATIONS - INITIAL HANDLING FACILITY (IHF)



IHF Key Features

- Receives transportation casks containing HLW and naval SNF canisters
- Loads disposable canisters into waste packages and closes the waste package
- No mitigation systems required because of waste forms handled
- ITS seismic steel and concrete structure
- ITS mechanical handling equipment
  - Cask trolley
  - Cask handling crane
  - Canister transfer machine
  - Waste package trolley

IHF Layout

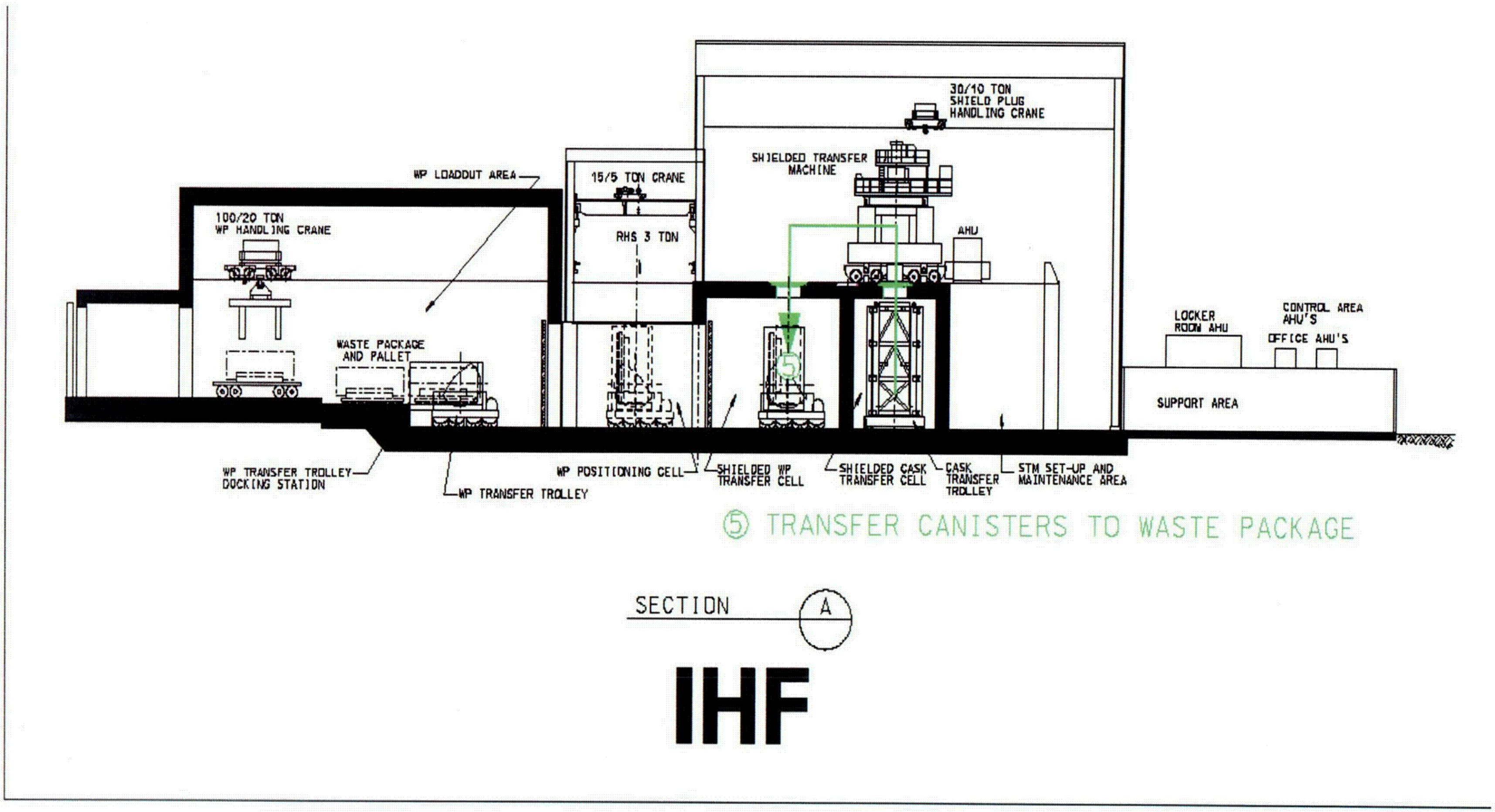


IHF

1. RECEIVE TRANSPORTATION CASKS
2. REMOVE PERSONNEL BARRIERS AND IMPACT LIMITERS
3. PREP CASK FOR UNLOADING
4. TRANSFER CASK TO UNLOAD STATION
5. TRANSFER CANISTERS TO WASTE PACKAGE
6. SEAL WASTE PACKAGE
7. INSPECT COMPLETED WASTE PACKAGE
8. LOAD WASTE PACKAGE ON EMPLACEMENT TRANSPORTER
9. EMPLACE WASTE PACKAGE

C-13

IHF Layout



C-14

Example-1 IHF Event Sequence

- **Drop with breach of an HLW canister**

  (During transfer from a transportation cask to a waste package using the canister transfer machine. The HLW canister drops onto another HLW canister previously transferred to the waste package.)

  - **Canister transfer machine drop rate 1×10^{-5} drops per lift**
  - **Category 2 event sequence**
  - **Material at risk is 2 HLW canisters**

Example-2 IHF Event Sequence

- **Drop of a transportation cask w/o impact limiters containing Naval SNF canister**

  (During transfer from a railcar to the cask trolley using the cask handling crane)

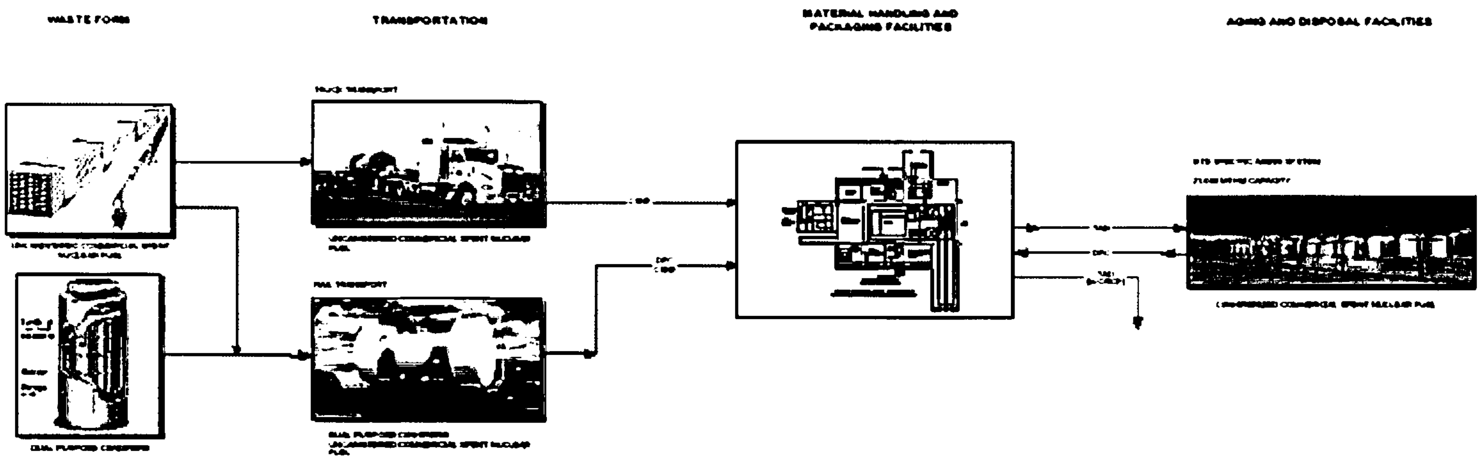
  - Cask handling crane drop rate 1×10^{-5} drops per lift
  - Category 2 event sequence
  - Material at risk is 1 Naval SNF canister
  - Assumed breach of transportation cask

IHF PHA Results

- No Category 1 Event Sequences
- Bounding Category 2 Event Sequence (drop of a lid on a loaded, open waste package resulting in the breach of 5 HLW canisters) TEDE offsite dose is << 5 rem
- SSCs identified as candidates for Important-to-Safety:
  - Building (e.g., designed for seismic, high winds / tornado / tornado missiles)
  - Cask handling crane
  - Cask and waste package trolleys
  - Canister transfer machine
- No ITS HVAC/HEPA filtration or ITS electrical power supply required to meet 10 CFR 63 performance objectives

WHF Concept of Operations

CONCEPT of OPERATIONS - WET HANDLING FACILITY (WHF)



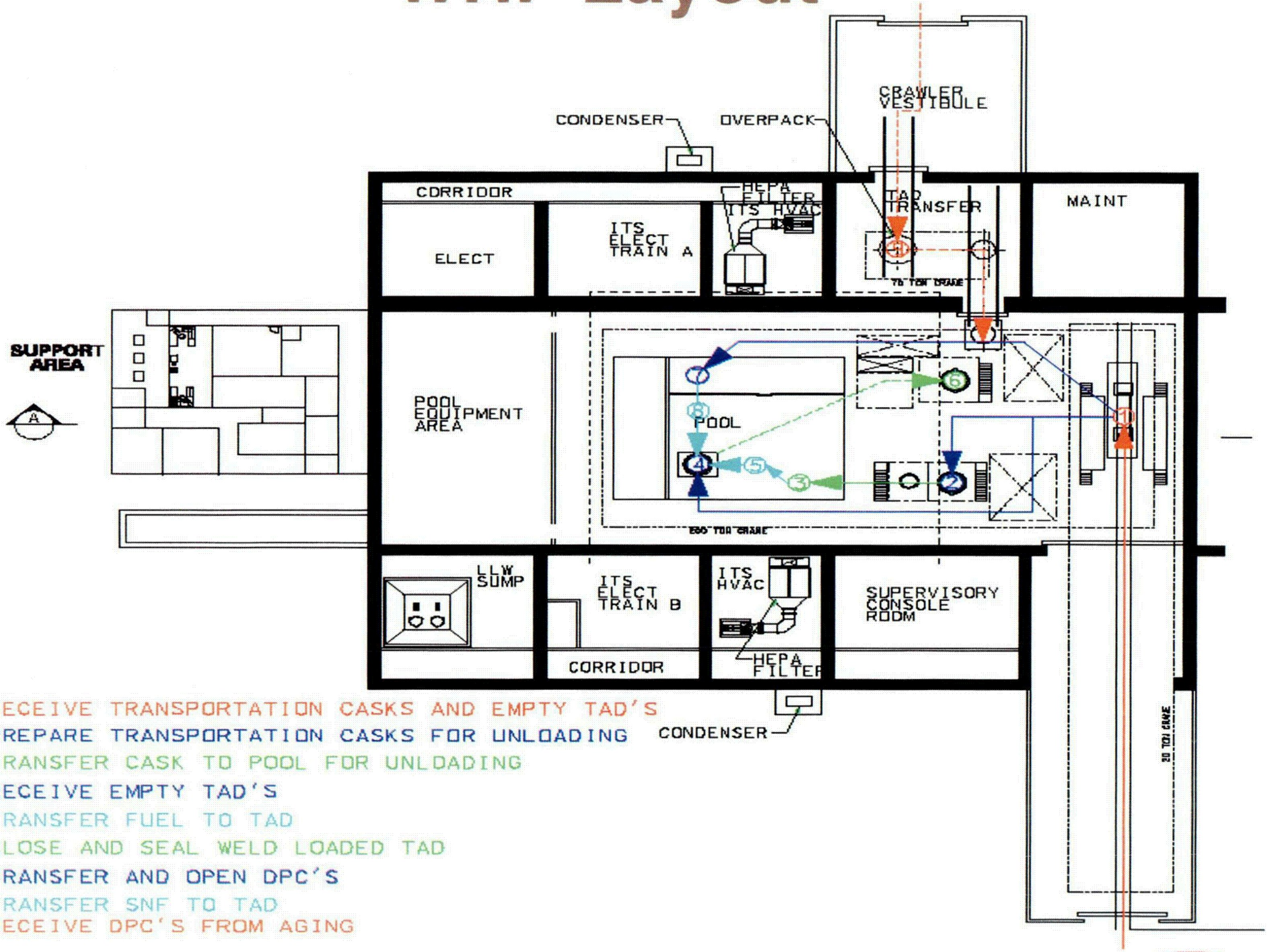
WHF Key Features

- Receives individual CSNF assemblies and DPCs, loads and closes TADs
- To prevent fuel oxidation, all bare CSNF will be handled under water
- To prevent fuel oxidation, DPCs will be handled and cut open under water
- Unborated fuel pool with staging capacity for individual CSNF assemblies
- Mitigates Category 2 event sequences:
  - Confinement
  - ITS HEPA filtered exhaust system
  - ITS electrical system

WHF Key Features (cont.)

- ITS seismic concrete structure with steel vestibules
- ITS mechanical handling equipment
  - Cask trolley
  - Cask handling crane
  - Spent fuel transfer machine
  - Canister transfer machine
- Provides wet remediation capability

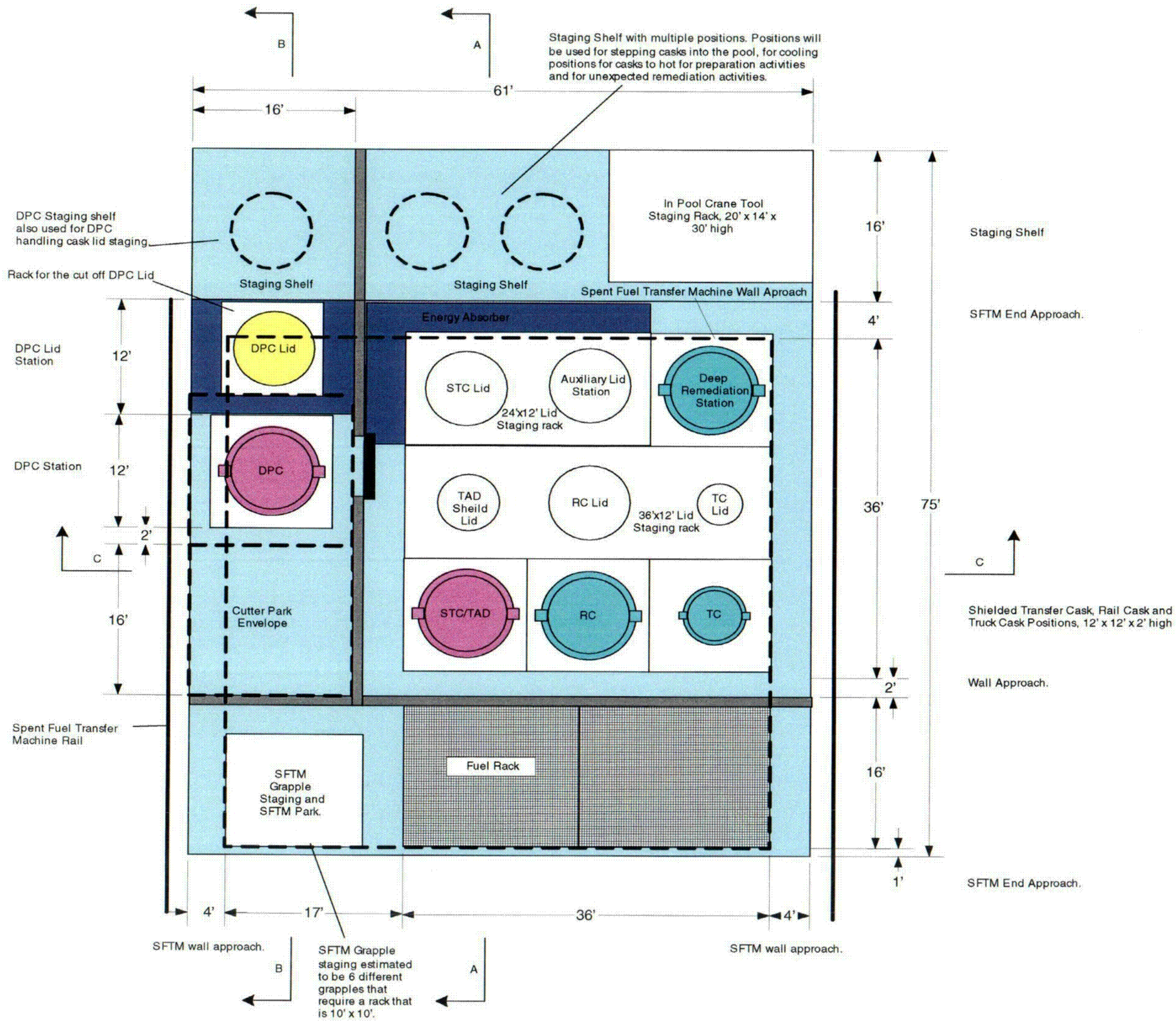
WHF Layout



① RECEIVE TRANSPORTATION CASKS AND EMPTY TAD'S
② PREPARE TRANSPORTATION CASKS FOR UNLOADING
③ TRANSFER CASK TO POOL FOR UNLOADING
④ RECEIVE EMPTY TAD'S
⑤ TRANSFER FUEL TO TAD
⑥ CLOSE AND SEAL WELD LOADED TAD
⑦ TRANSFER AND OPEN DPC'S
⑧ TRANSFER SNF TO TAD
⑨ RECEIVE DPC'S FROM AGING

C-15

WHF Pool Layout



C-16

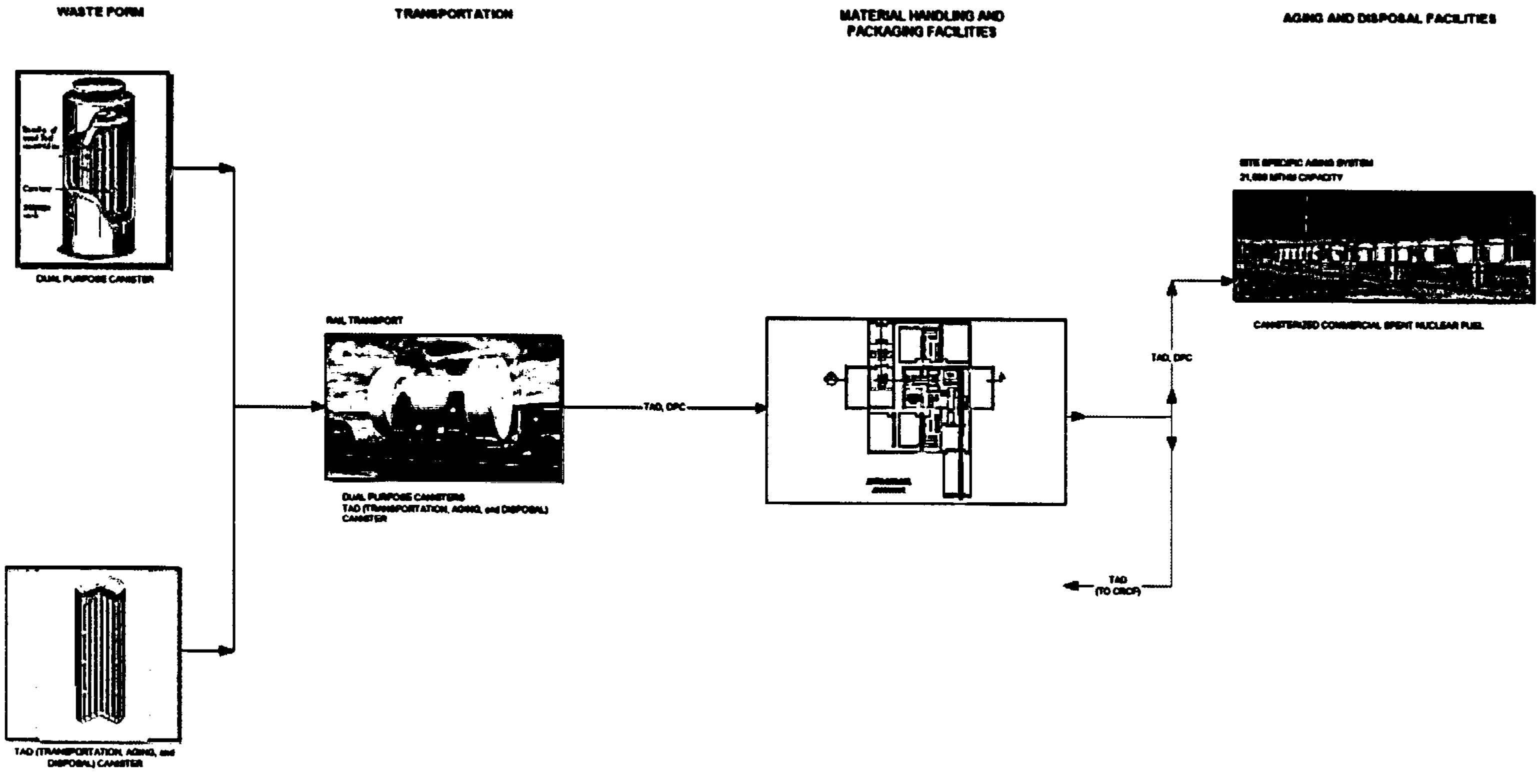
Example WHF Event Sequence

- **Drop of an unsealed TAD when in a shielded transfer cask during the lift from the pool to the closure area**
  - Overhead bridge crane drop rate 1×10^{-5} drops per lift
  - Category 2 event sequence
  - TAD is unsealed; shielded transfer cask assumed to breach, resulting in damage to TAD contents and release
  - Assumed cladding failure with radionuclide releases due to canister drop and fuel oxidation
  - Redundant ITS HVAC exhaust system with HEPA filtered releases

WHF PHA Results

- No Category 1 event sequences
- Bounding Category 2 event sequence (drop of transportation cask containing DPC filled with 36 PWR assemblies) TEDE offsite dose is << 5 rem
- SSCs identified as candidates for Important-to-Safety:
  - Building including Pool Structure (e.g., designed for confinement, seismic, high winds / tornado / tornado missiles)
  - Overhead bridge crane
  - Canister transfer machine
  - Cask trolley
  - Spent fuel transfer machine
  - HVAC exhaust system with HEPA filtration
  - Electrical power to HVAC exhaust system

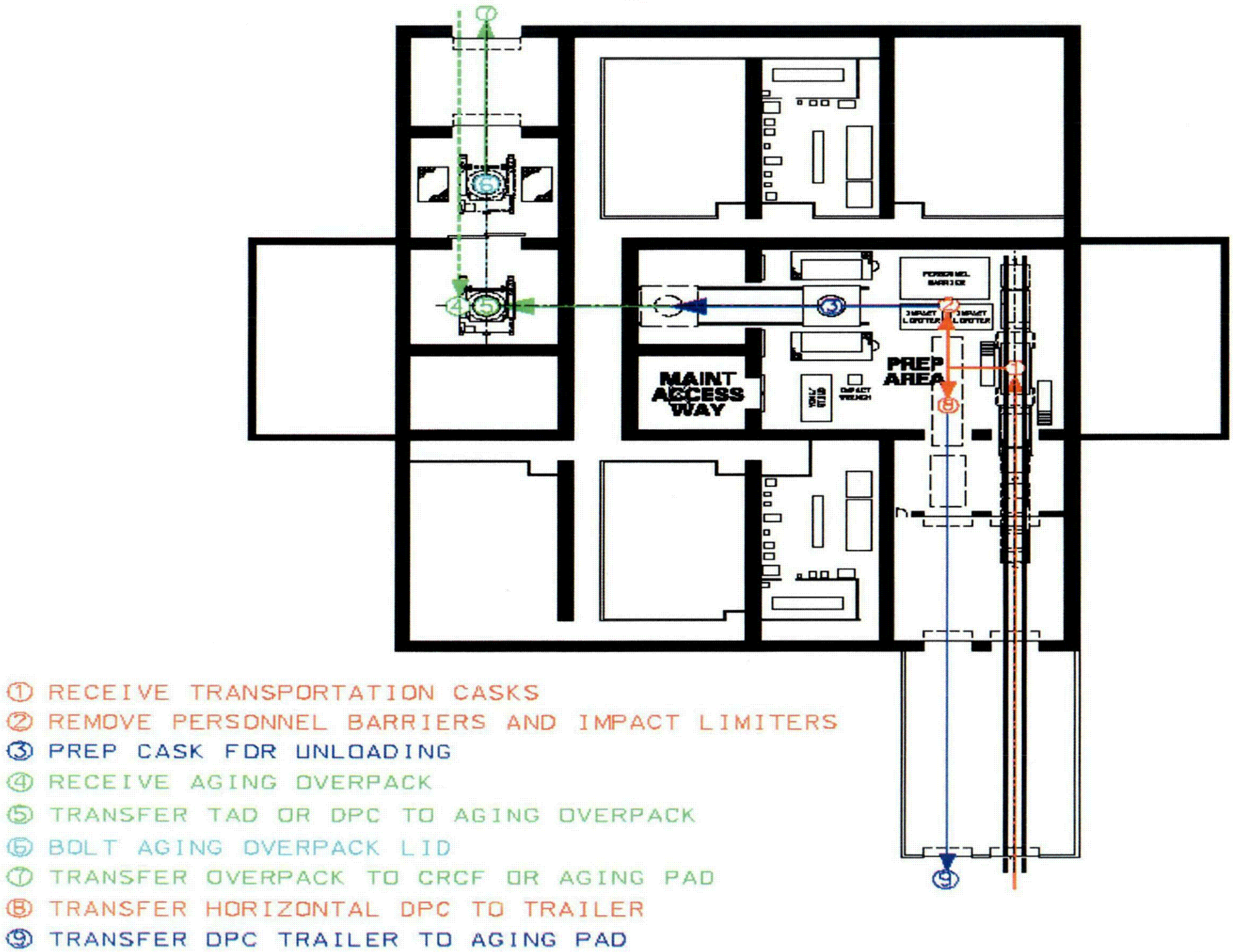
RF Concept of Operations



RF Key Features

- Receipt Facility is used to decouple the waste receipt rate from the emplacement rate
- Handles TADs and DPCs principally going to aging
- Mitigates Category 2 event sequences
  - Provides confinement
  - ITS HEPA filtered exhaust system
  - ITS electrical system
- ITS seismic concrete structure with steel vestibules
- ITS mechanical handling equipment
  - Cask trolley
  - Cask handling crane
  - Canister transfer machine

RF Layout



C-17

Example 1: RF Event Sequence

- **Drop of transportation cask w/o impact limiters from overhead bridge crane**
  - Overhead bridge crane drop rate 1×10^{-5} drops per lift
  - Category 2 event sequence
  - Assumed transportation cask breach containing a TAD or DPC
  - Assumed DPC or TAD breach with fuel cladding failure resulting in radionuclide releases due to drop and CSNF oxidation
  - Redundant ITS HVAC exhaust system with HEPA filtered releases

Example 2: RF Event Sequence

- **Drop of TAD or DPC from canister transfer machine into transportation cask, shielded transfer cask, or aging overpack**
  - Canister transfer machine drop rate $1x10^{-5}$ drops per lift
  - Category 2 event sequence
  - Assumed TAD or DPC breach when dropped into transportation cask, shielded transfer cask, or aging overpack
  - Assumed cladding failure with radionuclide releases due to drop and CSNF oxidation
  - Redundant ITS HVAC exhaust system with HEPA filtered releases

RF PHA Results

- No Category 1 event sequences
- Bounding Category 2 event sequence (DPC drop loaded with 36 PWR assemblies) TEDE offsite dose is << 5 rem
- SSCs identified as candidates for Important-to-Safety:
  - Building (e.g., designed for confinement, seismic, high winds / tornado / tornado missiles)
  - Overhead bridge crane
  - Canister transfer machine
  - Cask trolleys
  - HVAC exhaust system with HEPA filtration
  - Electrical power to HVAC exhaust system

Summary of CD-1 Effects on PHA

- **Handling of individual CSNF assemblies significantly reduced but not eliminated:**
  - Reduction from approximately 221,000 (dry) assemblies to approximately 22,000 (wet) individual assemblies
  - Preliminary evaluation shows no Category 1 event sequences
- **Handling of TADs and TAD casks that result in drops are Category 2 events**
  - Rely on ITS cranes, canister transfer machines, and HEPA filtration
  - Potential CSNF oxidation following TAD or TAD cask drop and breach mitigated by HEPA filters

Summary of CD-1 Effects on PHA

- **Total number of nuclear waste form transfers reduced:**
  - Canister staging areas reduced, resulting in fewer canister transfer operations
  - Use of TADs reduces the handling of individual CSNF assemblies
- **Total number of nuclear waste form lifts reduced:**
  - Surface facilities simpler, utilize fewer cranes
  - New WP trolley design eliminated crane lifts of WPs
  - Simpler WP loadout area design eliminates WP lifts
  - New transporter design eliminates subsurface WP lifts

CD-1 PHA Selected Results

Event Sequence Description	Expected Number of Occurrences over Preclosure Period	Offsite TEDE Dose (mrem)
Drop causing the breach of a naval canister. HEPA filtering not credited.	1.7×10^{-2}	1.5
Drop causing the breach of 5 HLW canisters inside an unsealed transportation cask or waste package. HEPA filtering not credited.	7.8×10^{-2}	24
Drop causing the breach of a DPC when handled in air (36 PWR or 74 BWR fuel assemblies). HEPA filtering credited.	5.7×10^{-2}	17
Drop causing the breach of a TAD canister when handled in air (21 PWR or 44 BWR fuel assemblies). HEPA filtering credited.	5.0×10^{-1}	9.8
Drop causing the breach of 2 fuel assemblies when handled in pool.	4.8×10^{-1}	0.4